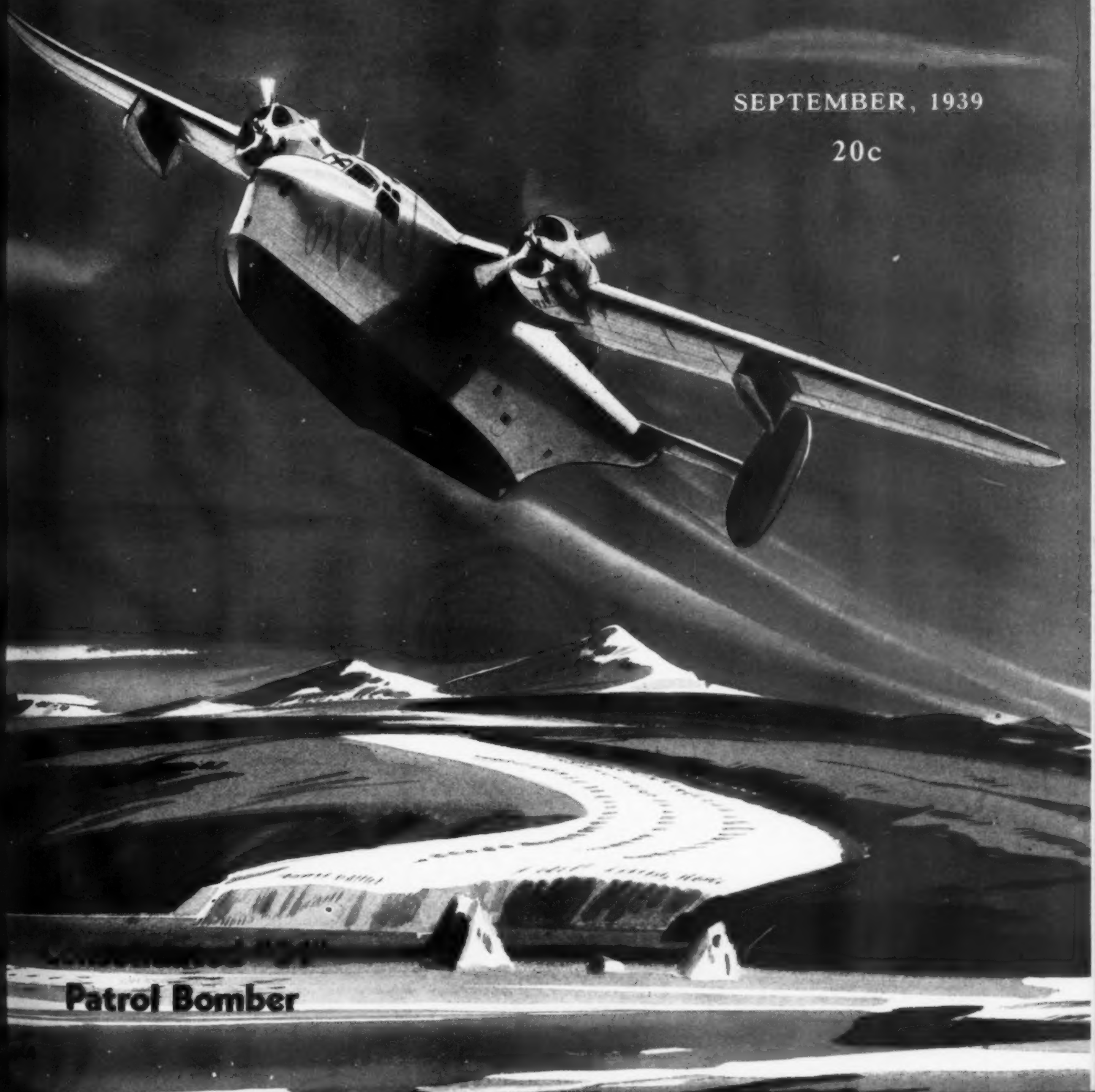
MODEL AIRPLANE NEWS

11th Year of Publication

SEPTEMBER, 1939

20c



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Whether it's endurance flying or accurate scale, shelf models or gas powered, "BURD MODELS" stand out at contests everywhere. Available in almost any type desirable, each of the one hundred "BURD MODELS" is a champion. Have you seen the latest "BURD MODELS"? Get a new catalog at your dealers, or ask him for "BURD." Don't accept something "just as good." Call for "BURD MODELS."

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Perfectly balanced, any diameter to 14" available in any desired pitch. 15" diameter 60c, 16" diameter 75c. **50c**

NEW 25c FLYERS WINGSPANS TO 33"

Add 15c packing if ordered direct.

TURNED COWLS — MOVABLE CONTROLS — COMPLETE

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"BURD" design makes possible a thrilling new line of low priced models with features seldom seen at many times the price. The sets are entirely complete including a large 4" tube cement. These models can be had at "BURD" dealers everywhere.

IN THE FOLLOWING TYPES

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No. 103 Ryan SC
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No. 106 Douglas 038
No. 107 Curtiss Jenny
No. 108 Monocoupe
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No. 110 Boeing P26
No. 111 Thermalider

The BURD 'Champion' GAS MODEL

72" WINGSPAN • 48" LENGTH
with DIE CUT FINISHED RIBS

Designed to meet the demands of the beginners and experts alike, the "BURD CHAMPION" has proven its name in contests throughout the country. The extreme simplicity in construction makes it especially desirable for those model builders who haven't had previous experience building gas models, and the splendid performance adds the touch of the true champion. The kit is absolutely complete containing all parts necessary to build the model of selected material only. Ask your BURD dealer to show you the new "BURD CHAMPION GAS MODEL." It can be seen anywhere. **$3.95**

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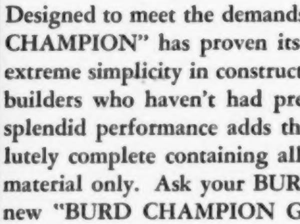

54 MINUTES—OFFICIAL TIME

The only rubber powered model in the world ever to perform so amazingly at a National meet. It has been proven time and again in contests throughout the country that splendid performance with this model is not unusual. Look for the winners at all endurance contests. You'll find the **BURD World Record Holder** placing one, two, three.

SIMPLE AS A B C TO BUILD AND FLY!

Even if you've never built a model before, BURD guarantees you flying satisfaction with this number. The set is complete and the construction is simple. Get it at your dealers today. It is an amazing value!

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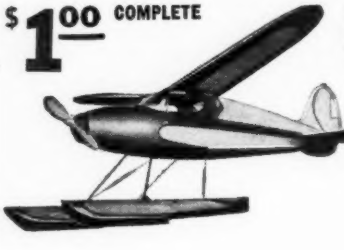
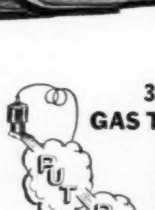
the SKEETER

$1.00 COMPLETE



Ideal for summer flying. Interchangeable wheels, floats and skis are standard in every set.

36" WINGSPAN GAS TYPE—MOTOR PUT



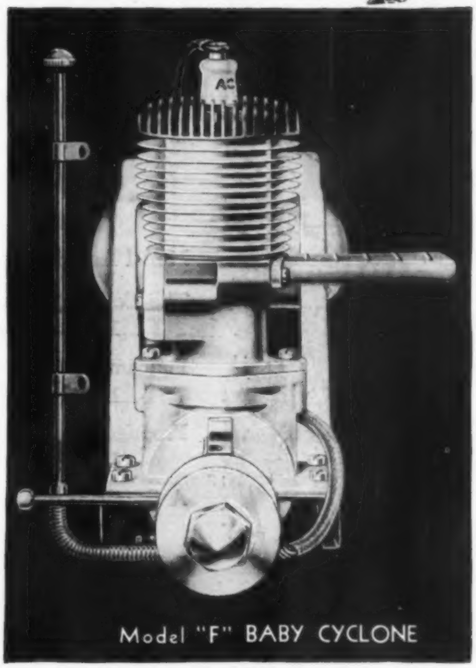
Looks exactly like a gas model and has the true motor hum. Enjoy the thrill of gas model flight without the expense, using the "PUT-PUT". **75c**

HEY—WAIT A MINUTE, BOYS!

Why pay more, when you can buy Baby Cyclone . . . a powerful, reliable and proven engine for only . . .

9 BUCKS

$9.00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The full resources of Aircraft Industries have been concentrated on building one engine and building it RIGHT. The sentational low temporary price is not the result of cheapening the materials or construction of a more expensive model. You make this saving by buying direct from the factory, whose production methods and tremendous volume of sales permit us to offer you a high quality motor at the lowest price. Baby Cyclone is the world's greatest value!

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CYCLONE SERVICE **Your engine positively will be shipped on same day your order is received.**

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PLEASE SEND ME POSTPAID THE FOLLOWING ITEMS CHECKED. I ENCLOSE POST OFFICE MONEY ORDER.

○ **BABY CYCLONE MODEL "F" — Completely assembled as described above. REGULAR PRICE $12.50— TEMPORARY PRICE $9.00**

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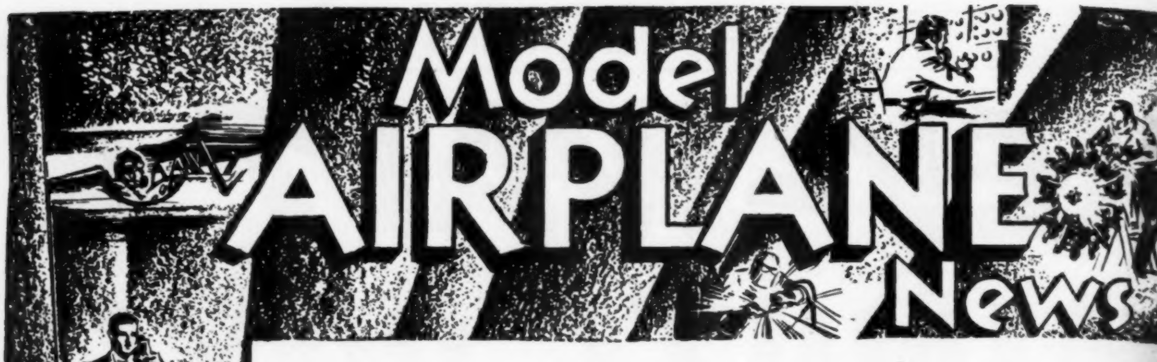

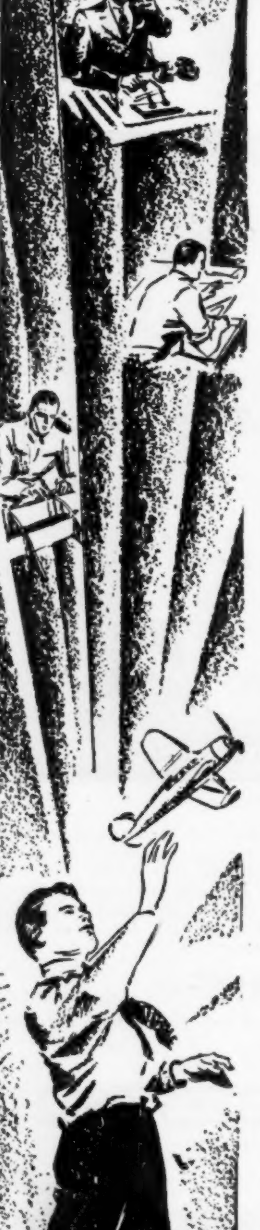

11th YEAR OF PUBLICATION

VOL. XXI *No. 3*

Edited by Charles Hampson Grant

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SEPTEMBER, 1939

Published Monthly by JAY PUBLISHING CORP., Mount Morris, Illinois.
Editorial and General Offices, 551 Fifth Avenue, New York City.
Jay P. Cleveland, President. N. Howard Williamson, Secretary.
Jay P. Cleveland, Advertising Manager, 551 Fifth Avenue, New York, N. Y.
Entered as second-class matter Dec. 6, 1934, at the post office at Mount Morris, Ill., under the act of March 3, 1879. Additional entry at New York, N. Y.

Price 20c a copy. Subscription price $2 a year in the United States and its possessions; also Cuba, Mexico and Panama.
$2 in Canada. All other countries $2.50 per year.
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The opening ceremonies at the field, led by Irwin Polk

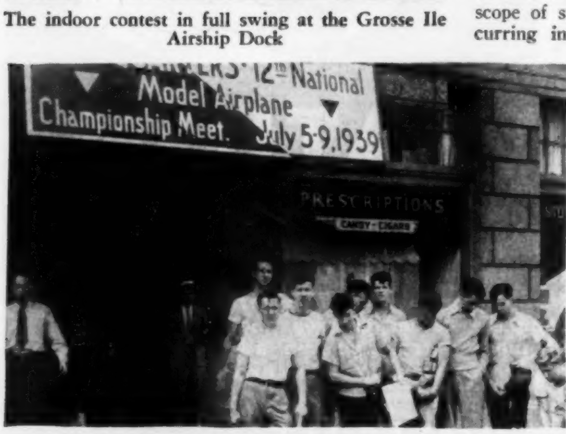
Andrew Peterson's plane makes a snappy take-off

The indoor contest in full swing at the Grosse Ile Airship Dock

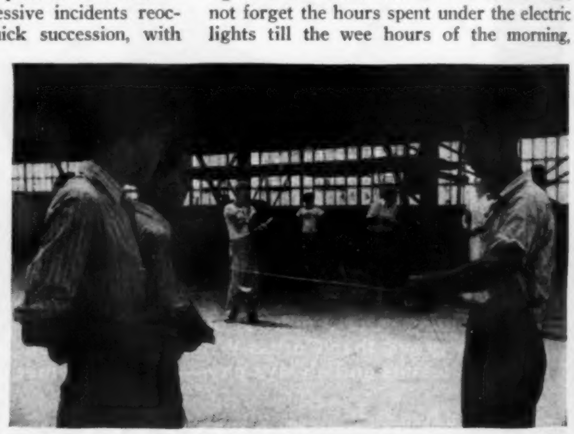
★ ★ ★ ★ ★ ★ ★ MODEL AMERICA ★ ★ ★ ★ ★ ★ ★

THE dizzy whirl of events and sleepless nights of the 1939 National Model Plane Contest, held at Detroit, Mich., July 5th to 9th, have now passed into the realm of history. Those who attended the affair retained the impression of a kaleidoscope of successive incidents reoccurring in quick succession, with which their senses never quite caught up.

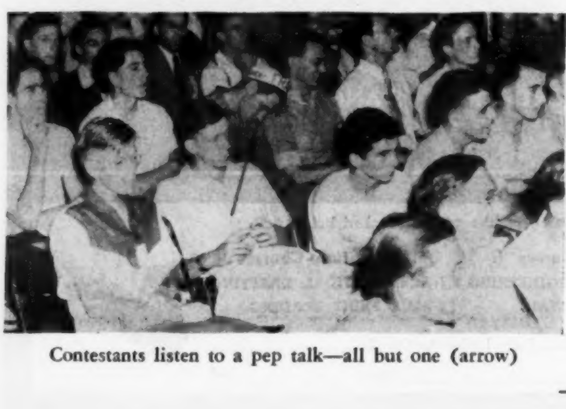
Eleven hundred boys, four days of going to the field in the morning, preparing planes under a blazing sun, waiting for timers, arguing about cross sections and area, rushing home at the end of the day—are highlights of the activities. Of course we must not forget the hours spent under the electric lights till the wee hours of the morning,



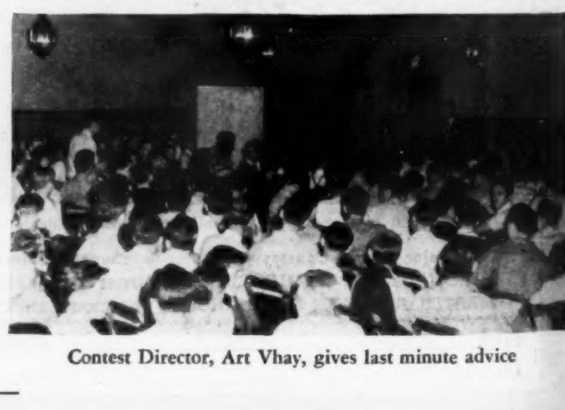
The Akron, Ohio, group wait for the airport bus



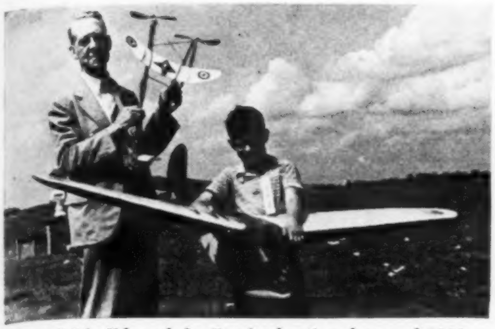
Preparing a fuselage job for flight at the "indoors"



Contestants listen to a pep talk—all but one (arrow)



Contest Director, Art Vhay, gives last minute advice



A model builder of the "early days" and one of 1939

Berryloid Winners; Joe Raspanti, C. Siegfried and Mike Roll

N.A.A.—Gas Lines—Air Ways

At The Nationals

repairing crack-ups and getting ships ready for the next day's events, and the ominous warnings of "The Wasp," twin brother to the "Green Hornet."

One undergoes all of these with great patience when he considers the compensation of meeting old friends and discussing the technique of model designing, building and flying by the experts. The Nationals is the annual classic which, in effect, is one round of activity from the opening day to the closing banquet. After that the contestants stagger homeward with a glazed look in their eyes and a lean look to their pocketbooks. To dwell in detail upon the many interesting happenings at the contest would be

Contestants with models leave the hotel elevator en route for the flying field

West Coast fans; Knapton, Christenson, Rice and Ohlsson fly to the meet in this Stinson

The workroom in the Fort Shelby garage is a busy place

House of the Youngstown boys for the duration of the meet

The Chicago Park District group watch test flights

The Berkley Flying Club listens to wise words of Joe Raspanti

Contestants weigh in before the (fight) flight

Henry Thomas Jr., Nat. Champ and Exchange Trophy

Charles H. Grant presents MODEL AIRPLANE NEWS Trophy to Bud McClellan

to gild the lily—in view of the pictures which we present here for your enlightenment. However a brief summary will not be out of place; this will enable our readers to coordinate the many individual incidents represented by the accompanying pictures.

On Tuesday the Fort Shelby Hotel, meet headquarters, suddenly broke from its leisurely routine into a cyclone of milling model builders, officials, sponsors, wives and friends from all parts of the country. Boxes, crates and packages containing models of all kinds poured into the hotel in a continuous stream. The registration office did a rushing business recording the contestants' names, addresses, etc., under the various events in which they were to participate: Stenographers and recorders were arm-weary.

As the contestants completed this first consideration they turned to the display room, in which many of the model dealers presented their products in grand array. One of the outstanding ex-

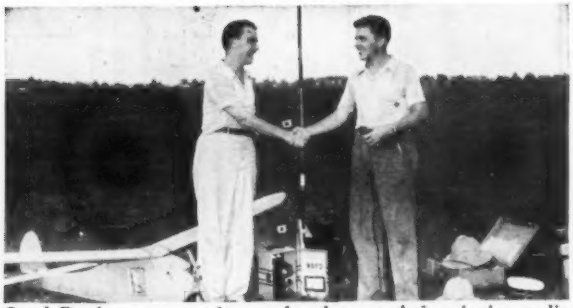
Ray Rouch, Garwood Trophy winner, and E. Barrow Jr., 2nd place

John Stokes, winner of the Bloomingdale Indoor Trophy

Class A winners; John Findra, Leo Shulman and Art Block

Stout Trophy winners; Bob Toft, Dick Everett and Ed Naudzius

Raspanti guides the take-off of his radio job. Taibi keeps pace



Good Brothers congratulate each other on their winning radio controlled flight

hibits was a new, opposed, twin gas engine which developed up to 1/2 horsepower. The shining colors of the MODEL AIRPLANE NEWS display, vibrating from an array of cover pictures that decorated one end of the room, lent character to the scene. No events were scheduled for Tuesday; this was the day for getting together and meeting old friends.

On Wednesday the opening exercises at the field started the ball rolling. Eleven hundred contestants descended upon the seventy timers, with little sympathy for the job that the latter had to perform. As the day wore on contestants gradually proceeded from the testing and adjusting stage of the competition to the undertaking of official flights. The Outdoor Cabin Event occupied most of their attention, together with the Eliminations for the Moffett International Event.

The second day was more or less a repetition of the first, except that the heat was more intense

(Continued on page 29)

Ed Roberts presents Radio Control Trophy to Walter and Bill Good

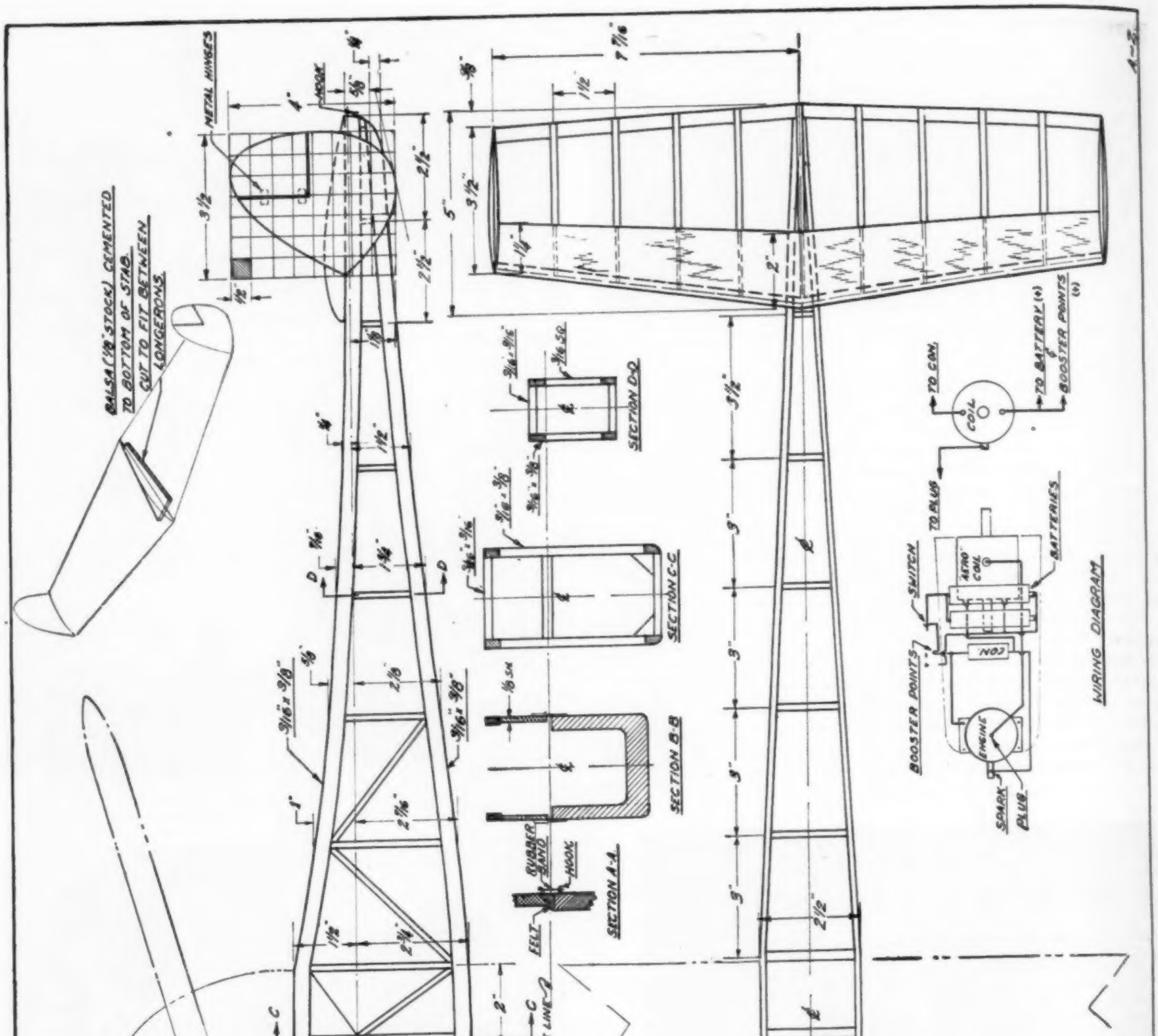
Korda, winner of the Wakefield Eliminations Trophy

The Flying Scale winners, except Thomas, with their planes

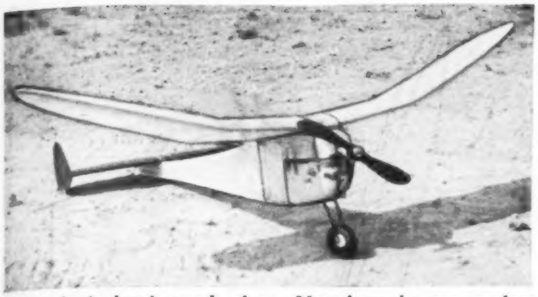
Indoor winners, Bill Stokes and Stanley Stanwick

Wheat Trophy Winners; Krehbiel, Velkoff, Wright, Lorenzen

Wakefield Team; Korda, Cahill, Chaille, Baker and Bohash



METAL HINGES
HOOK
BALSA (1/8" STOCK) CEMENTED TO BOTTOM OF STAB. CUT TO FIT BETWEEN LONGERONS
SECTION D-D
SECTION C-C
SECTION B-B
SECTION A-A
RUBBER BAND
FELT
REF. LINE
WIRING DIAGRAM
TO GRN.
COIL
TO BATTERY (+)
BOOSTER POINTS
TO PLUG
SWITCH
BATTERIES
SPARK PLUG
ENGINE
CHOKE
FELT PAD
BALSA DISK
CHOKE-SEE DETAIL
BASS BLOCK
SECTION E-E
ENGINE SUPPORT 3/8" SQ. BASS
SECTION F-F
WOOD SCREW
EXTEND NEEDLE VALVE
WIRE PRONG
CUT AWAY FOR EXHAUST
SECTION G-G (REVERSED)



A one wheeler but it stands alone. Note how the power plant weights are concentrated at the center of lift

The Colibri Takes The Air

How You Can Build and Fly a Gas Model of the Smallest Class That Weighs Only 12½ Oz. and Climbs Like a Rocket

By LOUIS GARAMI

SINCE the new 1939 gas model rules took effect, the poorest performance has been shown by the Class A group models.

The main reason for this is the 225 square inch maximum wing area limit which forces the builder to produce either a super-weak or a too heavy job for this class. Engine inefficiency and comparatively high wing loading, spells a poor climb and a steep glide. No wonder that the past contests were won by models averaging less than 60 seconds!

Naturally the rule is very young and builders did not have time to get around it like they always do sooner or later, but it will be a tough job to boost the performance figures where they really ought to be.

Here we have a model which tips the beam at 12 1/2 ounces and has a wing area of 225 square inches without being weak, and it is not a skeleton of an airplane either. Why, it even has an airwheel on it; but only one. We could not afford another one at 1/2 ounce a throw.

You might think that we mentioned this fact just for the fun of it; but when you consider that any reliable power plant with timer weighs over 8 ounces, it is easily seen that the model itself should not weigh over 4 ounces, which is less than a good rubber powered model of the same size.

In our model you will get a lot for your 4 ounces. A cowled-in engine, removable power plant, remote control choker and other practical improvements are all there to induce you to dust off the old Class A engine and take a crack at that 60 second record.

Body

Enlarge the drawing of the body sides onto a piece of cardboard or wrapping paper. For the longerons, use soft even-grained balsa. Make both sides together, one on top of the other. The top longeron goes all the way to the front of the body but since at the trailing edge of the wing the bend is sort of abrupt, better splice on a separate piece instead of trying to bend it. Do not forget to put all the diagonals in place. They are very important. Couple the two sides together with cross braces making sure that the body is in square and fill in the front with 1/8" sheet balsa. When finished it has an "Andy Gumpish" appearance, since the engine assembly is fully removable.

The engine housing is carved and hollowed out of two saft balsa blocks, each measuring 1 1/4" x 4 1/2" x 3". First they are glued together lightly and carved to shape outside to fit the body allowing for the thickness of the felt which lines both the body and the engine housing. The cross section of this part is square, with the bottom corner rounded off more and more toward the front.

We have used the Bantam engine in our model, but because Class A engines are more or less alike in size and shape, the size of the housing should be big enough for any of them.

Hollow out the housing to about 3/16" thickness except in the front where the thickness should be guided by the size of the engine cylinder. Mount the engine onto two short hardwood beams and cut two ledges in the balsa so that the beams will be sunk flush with the top of the housing.

Here it is in full flight, coming in on the glide. It is NOT suspended by wires

Now cement two hardwood pieces to the outside of the housing corresponding with the beams on the inside. Four wood screws will hold the engine firmly in place and at the same time in case the beams get oil soaked they can be replaced easily.

The rest of the ignition parts are laid out according to the wiring diagram shown on the plan. Make sure that the coil, which is the heaviest of the parts, is mounted in the very end of the housing. This is important to balance the model perfectly.

Coat the housing with light cement inside and out, otherwise the oil and gas will ruin it in no time.

The landing gear is bent out of 1/16" steel wire. It is cemented firmly on the inside of the housing and is protected by two large brass washers on the outside. The struts can be pried apart and the light airwheel set in place. In case of a hard landing, this type of strut proves very practical. Since very light wheels are in need of repair quite often, their being easily removable is a distinct advantage.

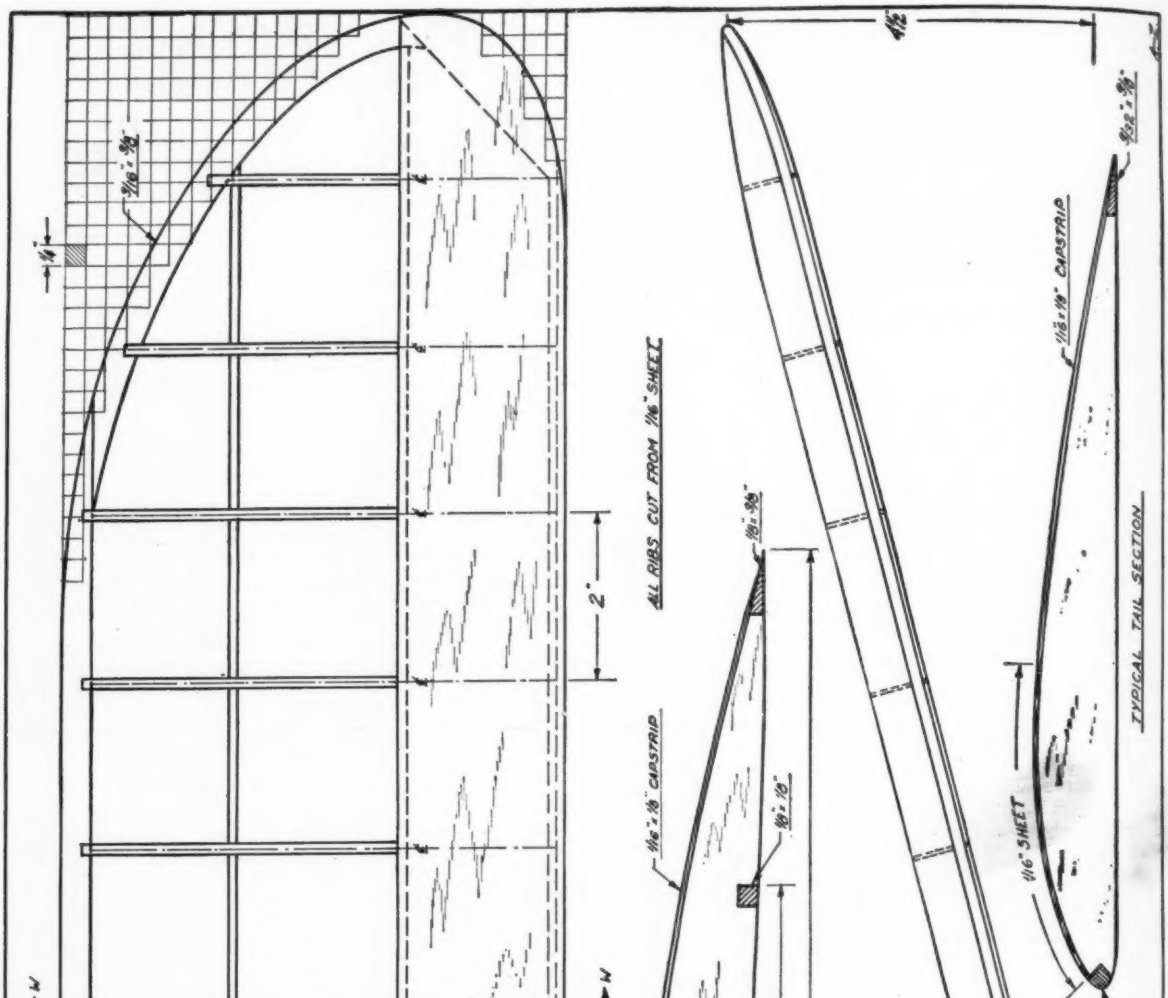
To keep the housing from shifting, 1/16" wire and large bushings to fit are cemented on the side of the housing and the body respectively. Besides, there are four wire hooks on each with rubber bands holding the housing firmly to the body.

Wing and Tail

The wing is made in two halves. There is no flat center section which prevents the wing from rocking. Cut all the ribs out of soft 1/16" stock. In fact to be able to reproduce a wing of the original weight every piece of wood used has to be of the light variety. The center ribs are tilted slightly to reach a dihedral of 1/2" at the fourth rib. For the tip dihedral you have to crack every spar first and then cut a 3/32" piece out of the top spar. Recement all spars firmly. The sheet balsa covering is in four sections. First always cement and pin to the top spar then bend down to the leading edge. Trim at the leading edge. Cap strip all ribs and sandpaper the whole framework carefully. The half circle cut out at the center is for the needle valve. On some of the motors this is not needed or its size can be reduced greatly. In fact our practice shows that the best way is to push the wing back an inch or so while revving up the motor and when it is all set just push it into place.

The stabilizer is constructed in a similar way as the wing, except for the lack of spars. Make sure that the end ribs are perpendicular. Sandpaper the sheet balsa rudders into a streamlined section and cover with tissue paper before attaching to the elevator. Cover the body with silk if you want to have a lasting job. Brush dope on the framework and put the silk on wet pulling it as smooth as you can. When it dries it tightens up beautifully. Cover the bottom of the wing with double tissue. Protect the wing trailing edge from chipping under the strain of the rubber

(Continued on page 47)


ALL RIBS CUT FROM 1/16" SHEET
2"
W
W
1/16" x 1/8" CAPSTRIP
SECTION W-W
FULL SIZE
6"
4"
2"
1/16" SHEET
1/8" x 1/8"
1 1/2" DIA.
1/16" SHEET
4 1/2"
1/2"
TYPICAL TAIL SECTION
1/16" x 1/8" CAPSTRIP
1/16" SHEET
1/8" x 1/8"

BY
CHARLES
HAMPSON
GRANT

Chapter No. 1—Article No. 2

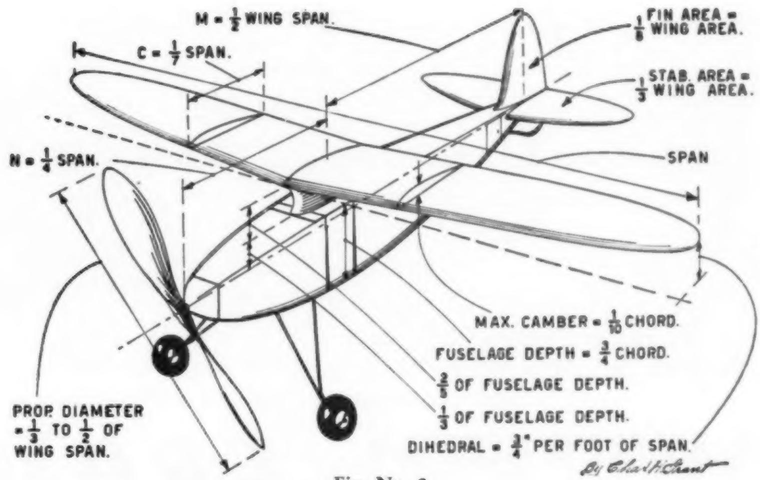


Fig. No. 2

Fundamentals of Model Plane Design

Principal Structural Units of an Airplane That Act to Fulfill the Requirements of Flight—How Lift is Generated

THE basic factors that an airplane must embody in order to lift from the ground, fly from one spot to another and land without damage, are as follows:

1. A Means of Lift.
2. A Means of Propulsion.
3. A Source of Power.
4. Stability.
5. A Means of Landing.
6. Connecting Structure.

If any mechanism embodies all these factors in correct relative proportion and to a sufficient degree, then it possesses all the qualities required to operate it as a successful flying device.

However this is not sufficient if it is to serve some useful purpose. It must possess more than the capacity to merely fly. It must be controllable to some degree at least; otherwise it would be impossible to direct its flight or cause it to execute any predetermined maneuver. In other words, it must embody the quality of CONTROLLABILITY.

Of course the satisfactory expression of this characteristic by the plane depends to a certain extent upon the knowledge and ability of the flier or pilot to direct the course of the craft. In the case of a full scale airplane the pilot maneuvers or directs it by moving the control surfaces through the operation of control mechanism.

There are no movable control surfaces on most model planes! All their surfaces are set in a fixed position during the course of any flight. If the model pilot wishes to have control surfaces operate to change its normal course of flight while it is in the air, then some automatic mechanical device must be incorporated in the plane to move them as desired. Obviously a human pilot cannot be on board the model ship to guide it.

The control of the average model originates from the fact that its surfaces may be set in such relative positions and attitudes that the intensity of the power and action of gravity at any moment cause the plane to act in a precise manner.

Thus the model flier, to a certain extent, may cause the plane to fly in a predetermined manner and direction. He cannot control the wind direction or air currents, but these may be taken into account and allowances made for them.

(Continued on page 62)

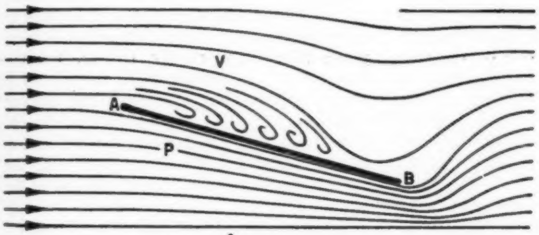


Fig. No. 3

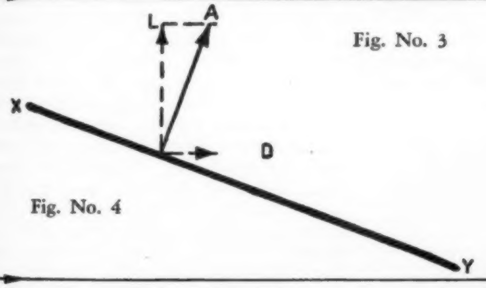


Fig. No. 4

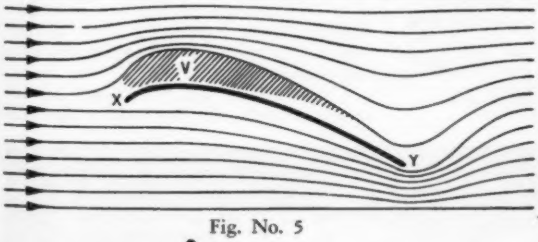
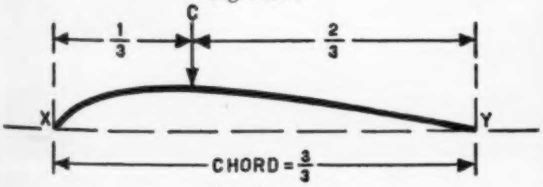


Fig. No. 5



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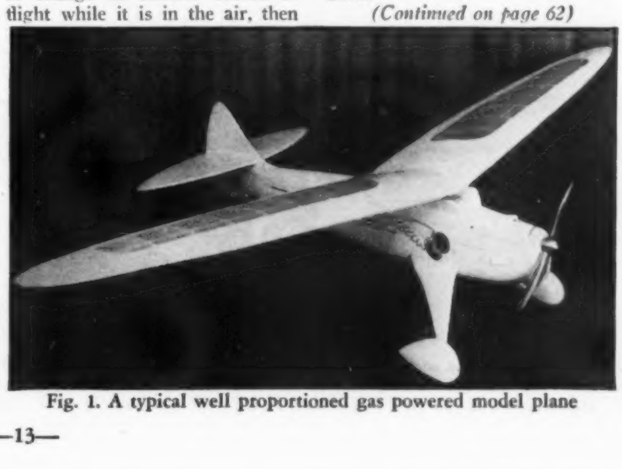


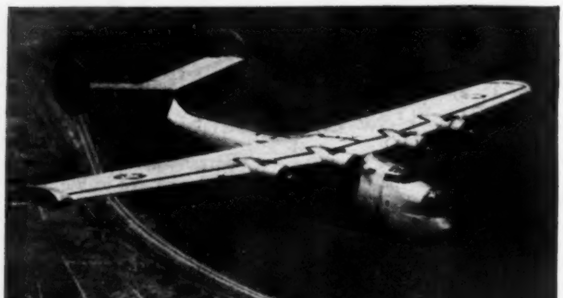
Fig. 1. A typical well proportioned gas powered model plane

The Consolidated trans-Atlantic survey plane above the clouds. (Morrison)

FRONTIERS

By ROBERT C. MORRISON

ENGLAND'S favorite airplane is the mighty little Bristol "Blenheim." It is one of the fastest twin-engined military ships on all Europe, and with a goodly store of bombs housed in its belly it is one of England's most potential air weapons. Though we could never understand why the English went to all the trouble of building some of those "airplanes" they now have, such as the Avro Anson, we must break down and admit that we like the Bristol "Blenheim" very much. It is the type of airplane that would fit well into our attack-bomber class.

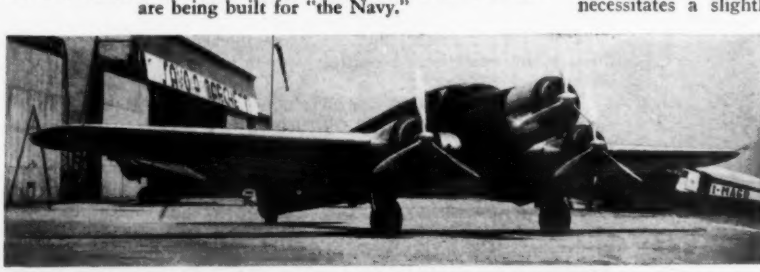


The new Consolidated XPB2Y-1 patrol bomber. A fleet of these are being built for "the Navy."

Now Bristol presents a new twin-engined, mid-wing airplane, one of the first of the new designs that we have been waiting for from England. It is of the same general appearance as the "Blenheim"—the same tail design and wing plan form. Known as the Bristol "Beaufort," it is designed as a reconnaissance torpedo bomber and as such necessitates a slightly larger airplane than the "Blenheim." The powerplant consists of two of Bristol's new Taurus sleeve-valve engines that develop about 1,000 hp. at take-off. They are of small diameter and because of the increased size of the ship the engines are not as prominent as they are on the "Blenheim." The pilot perhaps does not feel so snug as when between the larger engines that sheltered him from enemy bullets, but the "Beaufort" has added speed to pull away from its pursuers. As usual the exhaust manifold is in the leading edge of the engine cowl and cooling flaps are installed. Three-bladed propellers are used with the thrust line just below the chord line of the wing.

The fuselage differs from the "Blenheim" in that at the mid-ship's point the contour of the top drops abruptly for the installation of a gun turret. This break in contour perhaps does not slow the plane many miles an hour, but on the planes to come where designers say they will get speeds up around 300 and 400 m.p.h. any such feature would be prohibitive. The English appear to be having trouble with their rear gun turrets because of lack of elbow room, necessitating large cumbersome glass enclosures. Even the clean lines of the Lockheed "Hudsons" going to England are marred by the ugly looking rear gun turret. However there is now a "Hudson" in England with a retracting turret that may solve the problem.

The speed of the "Beaufort" has not been disclosed. But we wonder that with



The Italian Savoia Marchetti S-79 three engine racer. It has a speed of 281 m.p.h. and is equipped with slots and flaps (Bulban)

Hans Grade flies the same plane on his 60th birthday that he flew in 1909. It is the same in principle as the planes of today. The construction is the only factor that is different (Internat'l)

The Civil Aeronautics Authority prohibits planes with lifting stabilizers. Model plane designers have proved they give greater *stability*. This 40 h.p. Mauboussin upholds their contention.

Ted Bellak, an old model builder, takes off on his record flight across Lake Erie (Acme)

OF AVIATION

the very high speed that the airplane must attain together with that added by C. G. Grey, editor of "The Aeroplane," the torpedo bomber will be able to dodge the onslaught of those Heinkels and Messerschmitts that are reported to be getting closer and closer to the 500 m.p.h. mark; and if the "Beaufort" is to do any fighting in the near future it will be against those famous German airplanes.

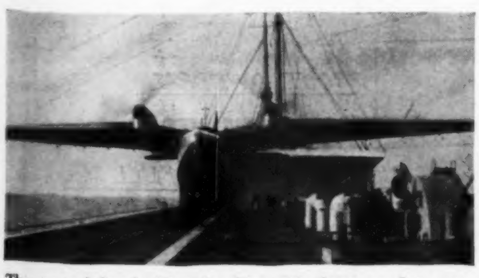
There are no wing fillets except for a slight fairing at the trailing edge. It was startling news when Jack Northrop introduced the wing fillet on his Gamma model many years ago and then the wing fillet was seen on all airplanes from then on until Lockhead came along with their Electra. Fillets were originally designed for this airplane, but then Lockheed surprised everyone by discarding them. Now it is news when a company does not use wing fillets. That has been the way with aircraft design from the start. Wing flaps have come and gone and then reappeared, the nose wheel is on one month and off the next, and even now designers are thinking about bringing the tail first idea into existence for the nth time.

Another of John Bull's new fighters is the Martin-Baker single-seater which again brings many features that were thrown out a few years ago . . . . . but here they are, all back again as big as life. About the nearest thing to the Martin-Baker in this country was the "Delgado Maid" that did a nice bit of taxiing at the National Air Races a couple of years ago. It probably is not fair though to compare this new Martin-Baker with the Delgado racer for it *(Continued on page 36)*

Ted Bellak receives the pouch of mail carried on his flight

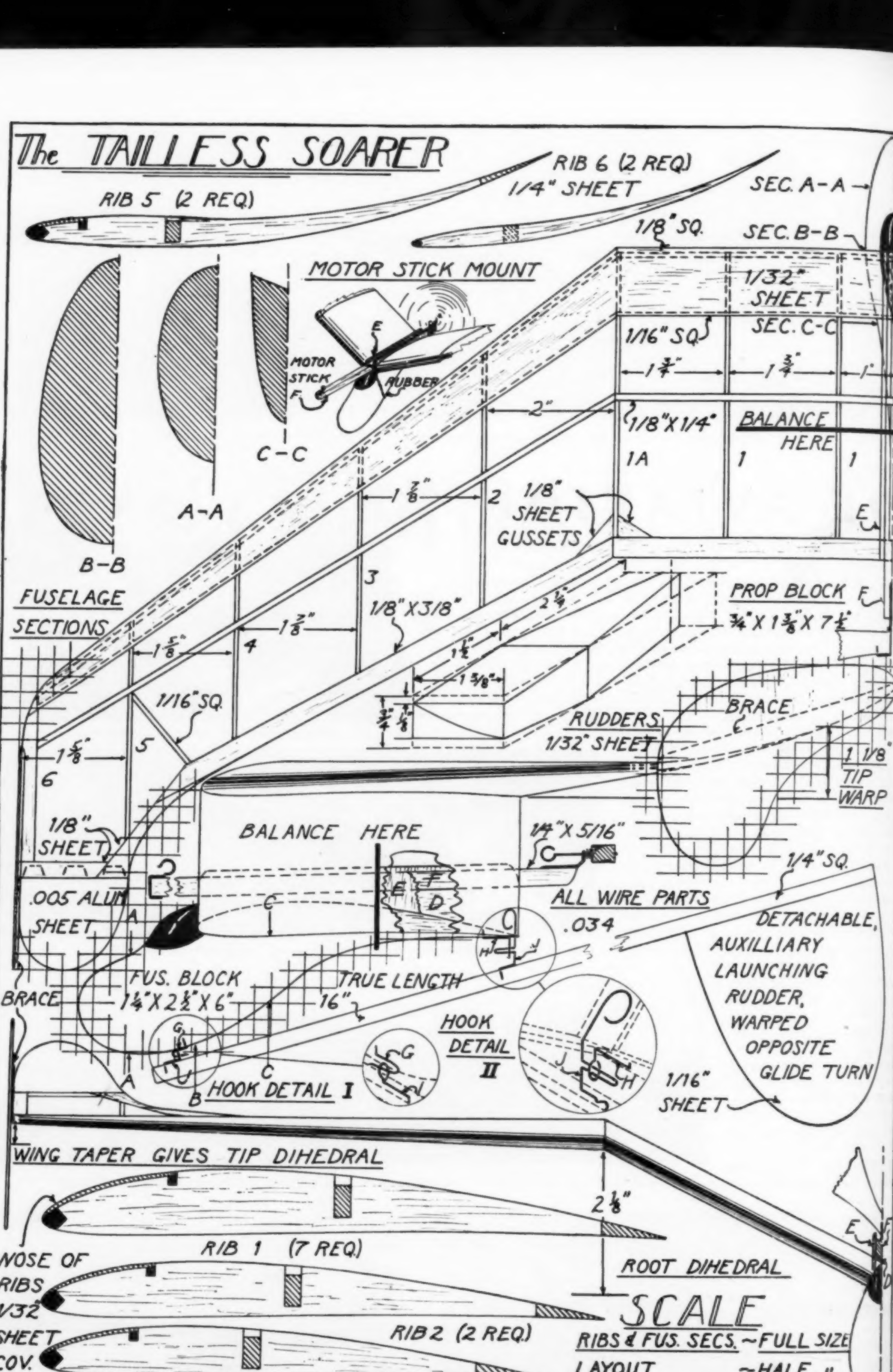
One of the Consolidated patrol bombers recently ordered by the U.S. Navy (Internat'l)

A fleet of Handley Page bombers ready to take off for maneuvers in England (Globe)



The trans-Atlantic Dornier Do. 26 about to be catapulted from its mother ship (Monkemeyer)

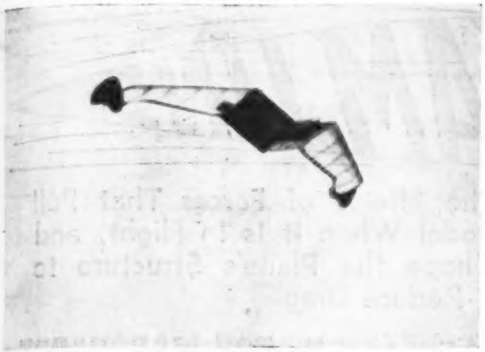
230 of these North American trainers with slots and flaps have been ordered by France for delivery (Morrison)


The TAILLESS SOARER
RIB 5 (2 REQ)
RIB 6 (2 REQ)
1/4" SHEET
SEC. A-A
SEC. B-B
SEC. C-C
1/8" SQ.
1/32" SHEET
1/16" SQ.
MOTOR STICK MOUNT
MOTOR STICK
RUBBER
B-B
A-A
C-C
FUSELAGE SECTIONS
1/8"X 1/4"
BALANCE HERE
1/8" SHEET GUSSETS
PROP BLOCK
3/4" X 1 3/8" X 7 1/2"
1/8" X 3/8"
1/16" SQ.
RUDDERS 1/32" SHEET
BRACE
1 1/8" TIP WARP
1/8" SHEET
BALANCE HERE
1/4" X 5/16"
1/4" SQ.
.005 ALUM SHEET
ALL WIRE PARTS .034
DETACHABLE, AUXILLIARY LAUNCHING RUDDER, WARPED OPPOSITE GLIDE TURN
FUS. BLOCK 1 1/4" X 2 1/2" X 6"
TRUE LENGTH 16"
BRACE
HOOK DETAIL II
HOOK DETAIL I
1/16" SHEET
WING TAPER GIVES TIP DIHEDRAL
2 1/8"
RIB 1 (7 REQ.)
NOSE OF RIBS 1/32 SHEET COV.
ROOT DIHEDRAL
RIB 2 (2 REQ)
RIB 3 (2 REQ.)
RIB 4 (2 REQ)
SCALE
RIBS & FUS. SECS. ~ FULL SIZE
LAYOUT ~ HALF "
SKETCHES NOT SCALE
SQUARES = 1/4"

A Soarer Without a Tail

A Soaring Plane That Performs With Exceptional Stability and Provides Unlimited Flights

By HENRY STRUCK



The tailless soarer in full flight: One of the finest of this type ever designed

THE tremendous success of the conventional tractor airplane has brought about its acceptance by most model builders as the ultimate in contest design. Consequently few have thought it worth while or necessary to delve into the so-called "freak" or novelty field. That such ventures are worthy of anyone's efforts may be readily seen from one of our own trips into these "dark woods" of model airplaning, which resulted in the capture of a spirally and longitudinally stable tailless soarer.

The relocation of the corrective force of the dihedral angle, ahead of the center of gravity, through the use of a straight center section coupled with generous reverse camber and sweepback of the wing tips, is responsible for the unusual amount of stability in our design. With the stability problem overcome, the natural advantages of low drag, great efficiency and lighter yet stronger construction of the tailless type may be utilized to their fullest degree.

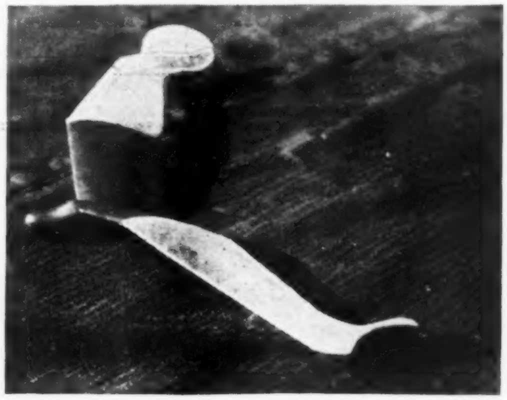
The first model we constructed was lost out of sight after seven minutes on its second flight from a tow-line. Another model was enthusiastically completed which performed even better, frequently soaring hand-launched! This plane was entered in a tow-line contest where it made the only real soaring flight in the weak currents of late afternoon. The time was five minutes, forty-nine seconds, out-of-sight.

The actual launching of the tailless, or for that matter of any other tow-line glider, is greatly facilitated by the use of an auxiliary rudder or "golf club." We all know that a fairly tight circle is required for effective soaring flight. With such an adjustment the towing of a glider is an almost impossible task. However when the rudder of the "golf club" is set to counteract the turn of the glider, it is easy to get the model as high as the line will allow. The further advantages of permitting the tow-line to be moved forward or back for varying wind conditions without different hooks, and the definite release caused by the drag of the rudder, make this device a most practical piece of tow-line glider equipment.

Due to the exceedingly simple construction, scarcely a day's work is necessary to turn out a tailless soarer. Before beginning actual construction it is best to make a full size drawing of the entire wing and other parts. Dimensions not given on the plans may be quickly found by doubling the measurements taken from the drawing, unless otherwise noted on the "Scale." The curved parts are marked off in one-quarter inch squares to aid in their reproduction.

Soft balsa of the quarter-grained variety used throughout makes it possible to construct this model of 110 square inch area as light as 1.1 ounces.

The first thing to do is to trace the wing ribs, given full size, on 1/16" sheet balsa. Seven No. 1 ribs and two each of all others are required. Note that the noses of the ribs are recessed to receive a 1/32" sheet balsa covering; also that No. 6 ribs are of 1/4" sheet.



The reverse camber wing tips provide perfect longitudinal stability

The trailing edge is built up of sections of 1/8" sheet glued together. Pin the trailing edge to a soft board, raising the portions from 1A outward to a height of 1 1/8" at the tips. Remember that the center section is to be perfectly flat. Only the swept-back panels are warped or "washed out."

The center No. 1, the No. 1A's and the No. 5 ribs are cemented to the trailing edge. The leading edge is glued against the noses of these ribs. The leading edge is NOT raised but remains parallel to the surface of the board. Insert the remainder of the ribs, the main spar of 1/8" sheet which is 1/4" high in the center section and tapered to 5/32" at the tip, and the stiffener spar of 1/16" square.

When the wing frame is thoroughly dry remove from the board and put 2 1/8" dihedral in each side of the center section. The outer panels are rejoined without dihedral, other than that caused by the taper of the wing.

The leading edge is carefully covered with 1/32" sheet balsa as far as the rear of the stiffener spar. Sandpaper the completed wing smooth and apply several extra coats of cement at all important points, particularly at the dihedral joints.

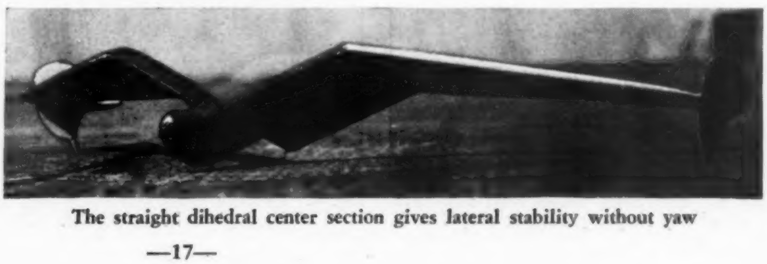
Cover the wing in conventional manner using separate pieces of colored tissue for each panel. The tissue must be doped to the undercamber of all ribs and to the top of the reverse camber No. 5 rib. The covered wing is lightly sprayed with water and doped when dry. Check the "wash out" of the wing frequently while drying during both the above operations. Distortion can be prevented by holding in the proper position until the covering has tightened.

The rudders are cut from 1/32" sheet balsa. A brace strip 1/32" x 3/8" is cemented across the grain to the inside of each to prevent splitting. They are covered on both sides, doping the tissue to the entire surface. Balsa surfaces treated in this fashion never warp and also retain well any adjustments made in them. Cement the rudders against each No. 6 rib, carefully checking their alignment in all directions.

Elevator trimmer tabs snipped from .005 sheet aluminum are forced into and cemented to the trailing edge.

A block 1 1/4" x 2 1/2" x 6" of soft balsa is required for the fuselage. The top outline is transferred to the 1 1/4" surface. After the block is cut to this shape the side pattern is similiarly treated. The body is

(Continued on page 54)



The straight dihedral center section gives lateral stability without yaw

STREAM LINES

Here You See the Effects of Forces That Pull Back on Your Model When It Is In Flight, and How You Can Shape the Plane's Structure to Reduce Drag

By ROY MARQUARDT

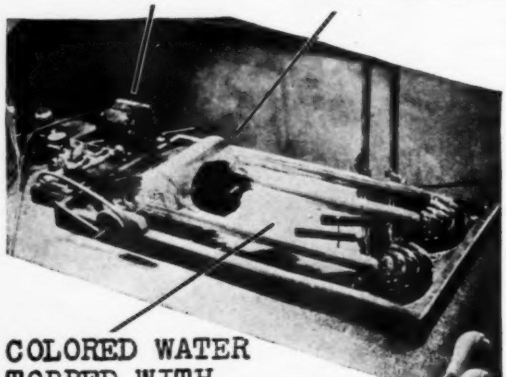
MODEL builders often wonder—WHY STREAMLINE? We are tempted to make box fuselages, struts, etc., to simplify things. Fortunately we can easily see the error in this by doing a little math. We find the surprising result that a single square foot of flat plate at the speed of a Thompson Trophy winner gives a drag of *240 lbs.!* A good heavy weight to carry around! In fact, it would absorb *120 hp.* just to keep this single square foot traveling at that speed. On the other hand, streamlining could reduce the hp. so much that a couple of Forsters could just about do the trick!

Or, in the other direction, we might have 100 square feet, a good sized barn door hung on the ship—if streamlined—and it would absorb no more hp.!

Yes, there is no doubt about it, streamlining is important. Even at 20 m.p.h., a usual gas model speed, a big square firewall such as we've seen on some jobs can absorb 1/5 the hp. of a Brown. No wonder some of the boys kick that their tubs just don't have any "umph"!

Probably by now you are convinced of the importance of streamlining, but you are wondering if, since we have been talking about math., there isn't some accurate way of going about the whole thing. Later we will present some wind tunnel data which will make accurate computations possible, but at present let me introduce a new method whereby you can actually SEE the results.

Large plane experimenters frequently use smoke but for our work another method seems better. Water, at low speeds, flows around objects in almost the same way as air. If the water is topped with aluminum powder, we may think of each aluminum



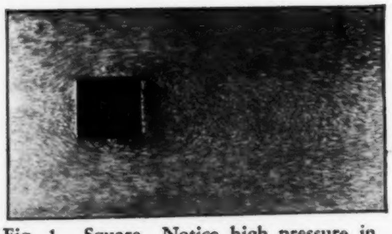


Fig. 1. Square. Notice high pressure in front, vacuum in rear. Resistance proportional to cross section area.

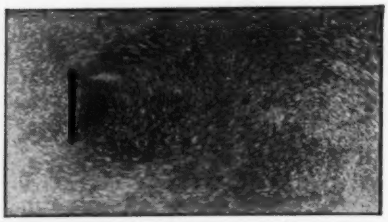


Fig. 2. Flat plate. Resistance about same as square (or oblong).

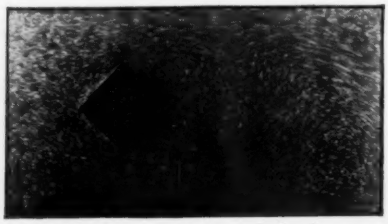


Fig. 3. Diamond. Cross of fuselage on edge incline. Slightly better than square.

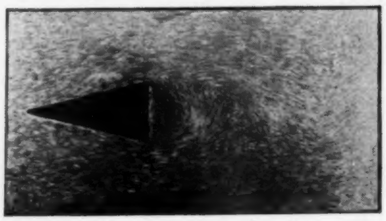


Fig. 4. Large drag produced at rear Notice the swirl behind it.

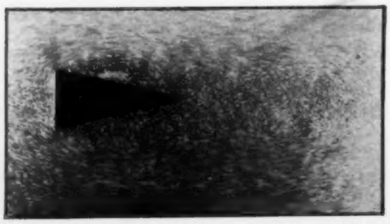


Fig. 5. Here the point is to the rear. This produces less resistance than point to the front. However flat point causes great pressure.

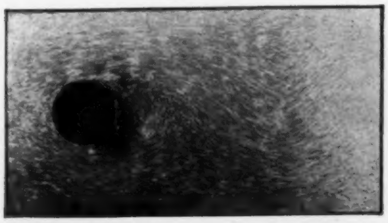


Fig. 6. The circle causes least resistance of any simple geometric shape.

Fig. 7. Combining semi-circle and triangle reduces resistance considerably. However flat sides cause drag.

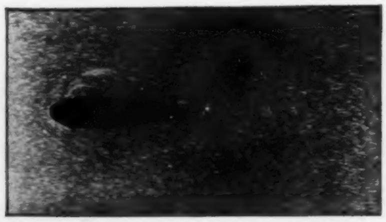


Fig. 8. Greatest cross section at 28% of chord gives better results.

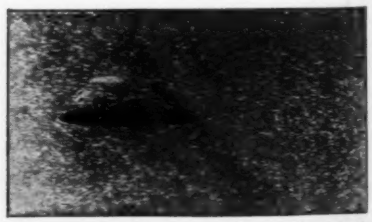


Fig. 9. Greatest cross section at about 34% back from the nose gives the best results. This is a standard NACA M-2 section.

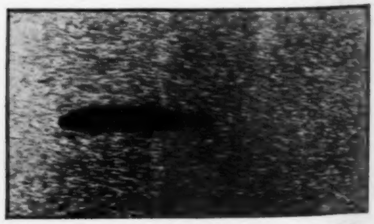


Fig. 10. This shows flow around section with thickness doubled.

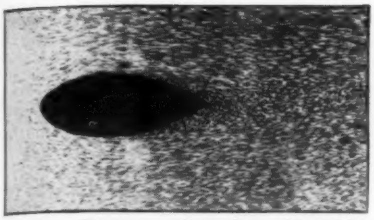


Fig. 11. Flow around section with thickness quadrupled. Notice whirls at rear.

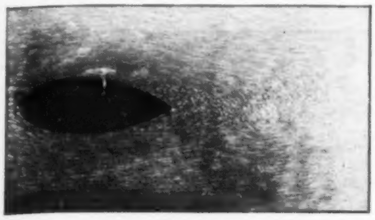


Fig. 12. Sections like these are better at low speeds than at high speeds.

particle as representing an air molecule. Best of all, the aluminum is easily photographed so that our results are available for all to examine.

Our study will be divided into two sections: first—streamlining; second—lift.

But before we examine the pictures in detail, let us review some of the mathematics involved. Obviously size is important. Any force on an object will vary directly with the size. If it is twice as large it will have twice the force. The most important variation, however, depends upon the speed. Consider air passing a stationary object. If we double the speed, there will be twice as many air particles hitting the object, and each particle will be hitting twice as hard. Therefore, the force varies according to the square of the speed—twice as great a speed having four times the force. This is of tremendous importance at high speeds as witness the 120 hp. absorbed by the flat plate on our Thompson Trophy winner.

Our formula, then, becomes FORCE = AREA × VELOCITY² × a COEFFICIENT (depending upon the shape). In the past few years a new formula has been adopted. Theoretically, from principles beyond the scope of this article, it can be shown that air against a flat plate will produce a

$$\text{FORCE} = \frac{\text{DENSITY OF AIR}}{2} \times \text{AREA} \times \text{VELOCITY}^2$$

($\frac{d}{2}$ = approximately .0012 at standard conditions. Velocity is in ft. per sec.) A constant (C_d) is, therefore, for a flat plate approximately 1. This is very useful for comparison. For example, if the flat plate is turned into a kite position, and shaped into an airfoil, the coefficient (now C_L) may become 1/2 again as great. If streamlined, the drag coefficient may go down to .01. The reasons will appear in the pictures.

Let us first consider a series of geometric shapes. The simplest is a flat plate or cube (Pictures 1 and 2). The length along the airflow ordinarily makes little difference; it is only necessary to consider the cross-sectional area. Notice the sharp curvature of the air at the front of the section. Pressure builds up here considerably. The air does not flow immediately around the section but leaves a spotty area of very low pressure. This vacuum is frequently more important than the high pressure in front.

In an attempt to reduce the front pressure area, we experimented with a triangle with the point to the front (Picture No. 4). This was an improvement but showed a tremendous drag in the rear. Notice that the pressure is so low that the air is sucked in immediately in twirls.

Reversing the triangle reversed the situation, being much better in back, and actu-

Fig. 13. Notice the effect of a rough surface. The rough surface causes whirls and creates great resistance.

Fig. 14. Two sections close together, as shown, give four times the drag of one section.

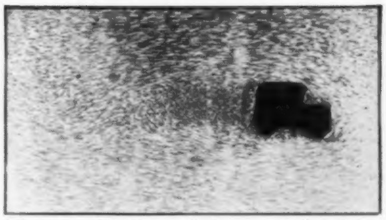


Fig. 15. Notice turbulence produced by 1920 car.

Fig. 16. A trailer at the rear fills in the vacuum and reduces the resistance.

Fig. 17. Better but far from perfect—the under part of body causes drag.

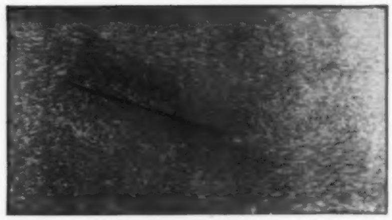


Fig. 18. A flat plate induces high drag with little lift.

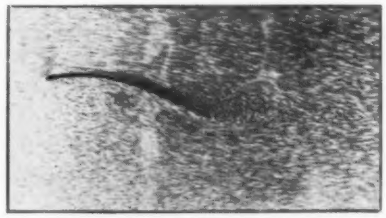


Fig. 19. The long lines over the McBride section indicate a high vacuum at this point and great lift.

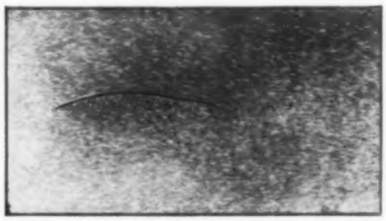


Fig. 20. A curved section is very effective at low angles. Notice drag on the nose.

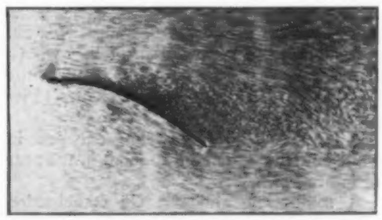


Fig. 21. At high angles the drag is great and lifts more. Notice whirls.

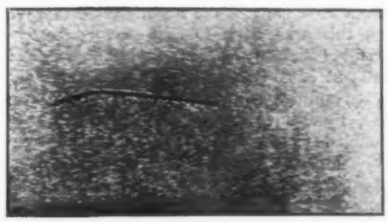


Fig. 22. Moving the hump forward increases both the lift and drag.

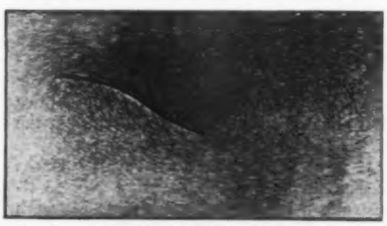


Fig. 23. The turned-up trailing edge increases the stalling angle and speed as well as the C.P. travel. This has great possibilities.

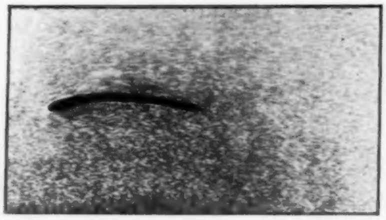


Fig. 24. The S-11 airfoil with bulgy nose and thickened section. The drag is reduced in this case.

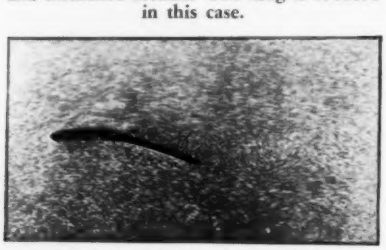


Fig. 25. The lift is very high.

Fig. 26. A slight up turn on the bottom of the trailing edge makes it very stable and reduces stalling.

ally showing less drag (Picture No. 5).

A diamond, a combination of the two (a diamond fuselage in a climb), shows the least drag of any straight line shapes (Picture No. 3).

A circle is still better, being excellent in front but still showing a vacuum in the rear (Picture No. 6).

A semi-circle and triangle combination proves to be the nearest streamlined of geometric forms (Picture No. 7). It has, however, its greatest cross-section at a point about 20% back of the leading edge. Moving this area back to 28% gave a better result (Picture No. 8), and still farther back at 35% (a standard M2 section) the best results were obtained (Picture No. 9). We now have an airfoil which can be doubled (Picture No. 10), or even quadrupled (Picture No. 11) without much greater drag coefficient. These thick sections have more use in model work than on large planes. Witness the use of chubby blimps traveling at low speed—approximately the same relation between air speed and size as in model work. However, never make a streamlined section thicker than 8% of its length unless you have to for a special purpose. Picture No. 12 illustrates the effect of increasing the air speed. Notice that about the same area is affected, but the swirls become much more pronounced.

It is also important to have all surfaces as smooth as possible. Picture No. 13 illustrates a rough-surfaced, double M2 with bumps. Since the air molecules are very small it is necessary to get all surfaces just as smooth as possible. If magnified, each bump is shown to produce its own tiny twirl. Even a coat of wax smoothing out extremely fine bumps on large ships may add as much as 10 m.p.h. to the speed. Nat-

(Continued on page 44)

Fig. 27. The Eiffel 431 is a similar section and causes high efficiency.

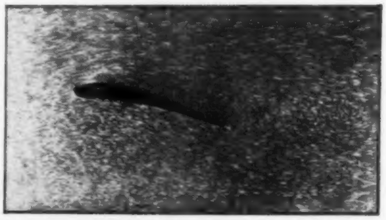


Fig. 28. Eiffel 431 at about four degrees.

Fig. 29. Eiffel 431 at about twenty degrees.

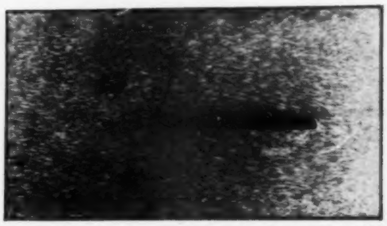


Fig. 30. By flattening the body a Clark Y section is formed.

Fig. 31. Clark Y at about fifteen degrees.

Fig. 32. Clark Y at about twenty-five degrees.

Fig. 33. Curve down the bottom surfaces and you have an M-6 section, giving low drag.

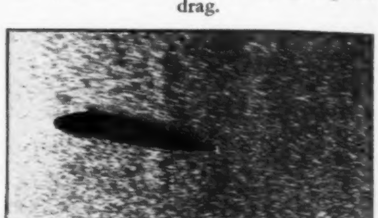


Fig. 34. The M-6 at low angle of attack. A very fast section.

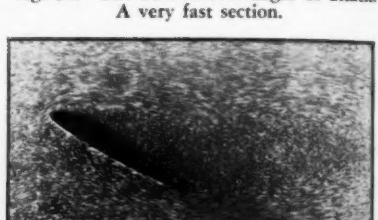


Fig. 35. The M-6 has a high stalling angle.

Fig. 36. Flow around negatively staggered surfaces.

Fig. 37. Flow around positively staggered surfaces.

Fig. 38. This shows the effect of a wing slot which reduces the "boiling" over the upper surfaces at the rear of the section when the wing is at high angles of attack. This reduces stalling dangers.

By LEON SHULMAN

Wing Loading At A Glance

TO DETERMINE at a glance the wing loading of any gas model, provided the area and weight are known, this chart has been designed. The weight of the model may be expressed in pounds or ounces and the area in square feet or inches. The answer is always indicated in ounces per square foot, the standard expression. The chart also will show whether the loading of the model is within the permissible limits; the minimum being eight ounces per square foot and the maximum sixteen ounces, which is shown for all models up to seven square feet.

The horizontal scale at the top of the chart expresses the weight of the model. The upper scale is calibrated in pounds, successive pounds being spaced four divisions apart, and each of the three intervening spaces between each pound may be taken as one-quarter pound more than the box to the left of it. The lower scale is calibrated in ounces to correspond with the pound scale above it. The lower scale progresses four ounces per box.

On the left of the chart will be found the scale showing the areas. The extreme left scale is in square inches, indicated every four boxes or one square foot apart. The inner scale is in square feet shown at quarter-square-foot intervals.

To find the wing loading of a model, find the weight on the top of the chart and the area on the side. Where the vertical column in which the weight is represented intersects the horizontal line on which the area reading happens to be, there will be found the correct wing loading.

As an example:

A gas model weighs 3-1/4 pounds (52 ounces), and has an area of 4.75 square feet. Where the corresponding columns intersect the answer will be found to be 10.9 oz./sq. ft.

If the columns happen to intersect in the large blank space on the left, the ship is underweight; if they intersect on the right blank area, the ship is overweight. This latter situation is allowed as long as the weight itself does not exceed seven pounds.

This chart will give readings for all gas models from one pound in weight to seven pounds and having an area of from one square foot to fourteen square feet.

It will allow you to determine, at a glance, whether or not your plane will fall within the wing loading specifications required by N.A.A. contest rules. Of course, in any contest you will wish to have your ship give as fine a performance as possible. Therefore it should have the minimum wing loading allowable; which is 8 oz. per sq. ft.

If your ship is to have a definite wing area then you may use the chart to determine the exact weight that the ship will have in order that the wing loading will be 8 oz. per sq. ft. For instance, if the area of the wing is 1008 sq. in., the ship will have to weigh 3½ lb., in order that the wing loading will be 8 oz. per sq. ft. Conversely, if you wish to build your ship to a particular weight, say 3½ lb., then the amount of wing area that will be required for any wing loading may be determined readily.

GAS MODEL WING LOADINGS

WEIGHT — POUNDS IN UPPER ROW. — OUNCES IN LOWER ROW.

AREA — SQUARE INCHES IN LEFT COLUMN. SQUARE FEET IN RIGHT COLUMN.

		1				2				3				4				5				6				7
		16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92	96	100	104	108	112
144	1.00	16.0
	1.25	12.8	16.0
	1.50	16.7	13.3	16.0
	1.75	9.14	11.4	13.8	16.0
288	2.00	8.00	10.0	12.0	14.0	16.0
	2.25		8.87	10.7	12.4	14.2	16.0
	2.50		8.00	9.60	11.2	12.8	14.4	16.0
	2.75			8.72	10.2	11.6	13.1	14.5	16.0
432	3.00			8.00	9.33	10.7	12.0	13.3	14.7	16.0
	3.25				8.60	9.85	11.1	12.3	13.5	14.8	16.0
	3.50				8.00	9.15	10.3	11.4	12.6	13.7	14.9	16.0
	3.75					8.54	9.60	10.7	11.7	12.8	13.9	14.9	16.0
576	4.00					8.00	9.00	10.0	11.0	12.0	13.0	14.0	15.0	16.0
	4.25						8.47	9.41	10.4	11.2	12.2	13.2	14.1	15.1	16.0
	4.50						8.00	8.89	9.78	10.7	11.6	12.4	13.3	14.2	15.1	16.0
	4.75							8.42	9.26	10.1	10.9	11.8	12.6	13.5	14.3	15.1	16.0
720	5.00							8.00	8.60	9.60	10.4	11.2	12.0	12.8	13.6	14.4	15.2	16.0
	5.25								8.38	9.15	9.91	10.7	11.4	12.2	12.8	13.7	14.5	15.2	16.0
	5.50								8.00	8.73	9.45	10.2	10.9	11.6	12.4	13.0	13.8	14.5	15.3	16.0
	5.75									8.35	9.04	9.74	10.4	11.1	11.8	12.5	13.2	13.9	14.6	15.3	16.0
864	6.00									8.00	8.67	9.34	10.0	10.7	11.3	12.0	12.7	13.3	14.0	14.7	15.3	16.0
	6.25										8.31	8.94	9.60	10.2	10.9	11.5	12.2	12.8	13.4	14.1	14.7	15.4	16.0
	6.50										8.00	8.60	9.23	9.85	10.5	11.1	11.7	12.3	12.9	13.5	14.1	14.8	15.4	16.0
	6.75											8.29	8.80	9.48	10.1	10.7	11.2	11.8	12.4	13.0	13.6	14.2	14.8	15.4	16.0
1008	7.00											8.00	8.56	9.14	9.70	10.3	10.9	11.4	12.0	12.6	13.1	13.7	14.3	14.8	15.4	16.0
	7.25												8.26	8.82	9.37	9.92	10.5	11.0	11.6	12.1	12.7	13.2	13.8	14.3	14.9	15.4
	7.50												8.00	8.54	9.06	9.60	10.1	10.7	11.2	11.7	12.3	12.8	13.3	13.8	14.4	14.8
	7.75													8.25	8.76	9.28	9.80	10.3	10.8	11.4	11.9	12.4	12.9	13.4	13.9	14.4
1152	8.00													8.00	8.50	9.00	9.50	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0
	8.25														8.24	8.73	9.20	9.69	10.2	10.7	11.1	11.6	12.1	12.6	13.1	13.6
	8.50														8.00	8.45	8.93	9.40	9.88	10.3	10.8	11.3	11.8	12.2	12.7	13.2
	8.75															8.23	8.68	9.19	9.60	10.1	10.5	11.0	11.4	11.9	12.4	12.8
1296	9.00															8.00	8.44	8.88	9.33	9.77	10.2	10.7	11.1	11.6	12.0	12.4
	9.25																8.20	8.65	9.08	9.50	9.94	10.4	10.8	11.2	11.7	12.1
	9.50																8.00	8.40	8.83	9.25	9.70	10.1	10.5	10.9	11.4	11.8
	9.75																	8.20	8.60	9.01	9.43	9.84	10.3	10.7	11.1	11.5
1440	10.00																	8.00	8.40	8.80	9.20	9.60	10.0	10.4	10.8	11.2
	10.25																		8.20	8.59	8.97	9.36	9.75	10.1	10.5	10.9
	10.50																		8.00	8.38	8.76	9.14	9.53	9.90	10.3	10.7
	10.75																			8.18	8.55	8.92	9.29	9.66	10.0	10.4
1584	11.00																			8.00	8.36	8.72	9.09	9.45	9.82	10.2
	11.25																				8.16	8.53	8.88	9.24	9.59	9.95
	11.50																				8.00	8.34	8.69	9.04	9.39	9.73
	11.75																					8.16	8.50	8.84	9.18	9.52
1728	12.00																					8.00	8.33	8.66	9.00	9.33
	12.25																						8.15	8.48	8.81	9.14
	12.50																						8.00	8.32	8.64	8.95
	12.75																							8.15	8.46	9.09
1872	13.00																							8.00	8.30	8.60
	13.25																								8.15	8.45
	13.50																								8.00	8.30
	13.75																									8.28
2016	14.00																									8.00

READINGS IN OUNCES PER SQUARE FOOT.

DESIGNED AND CALCULATED BY— LEON SHULMAN

CHECKED AND DRAWN BY— FELIX GILBERT

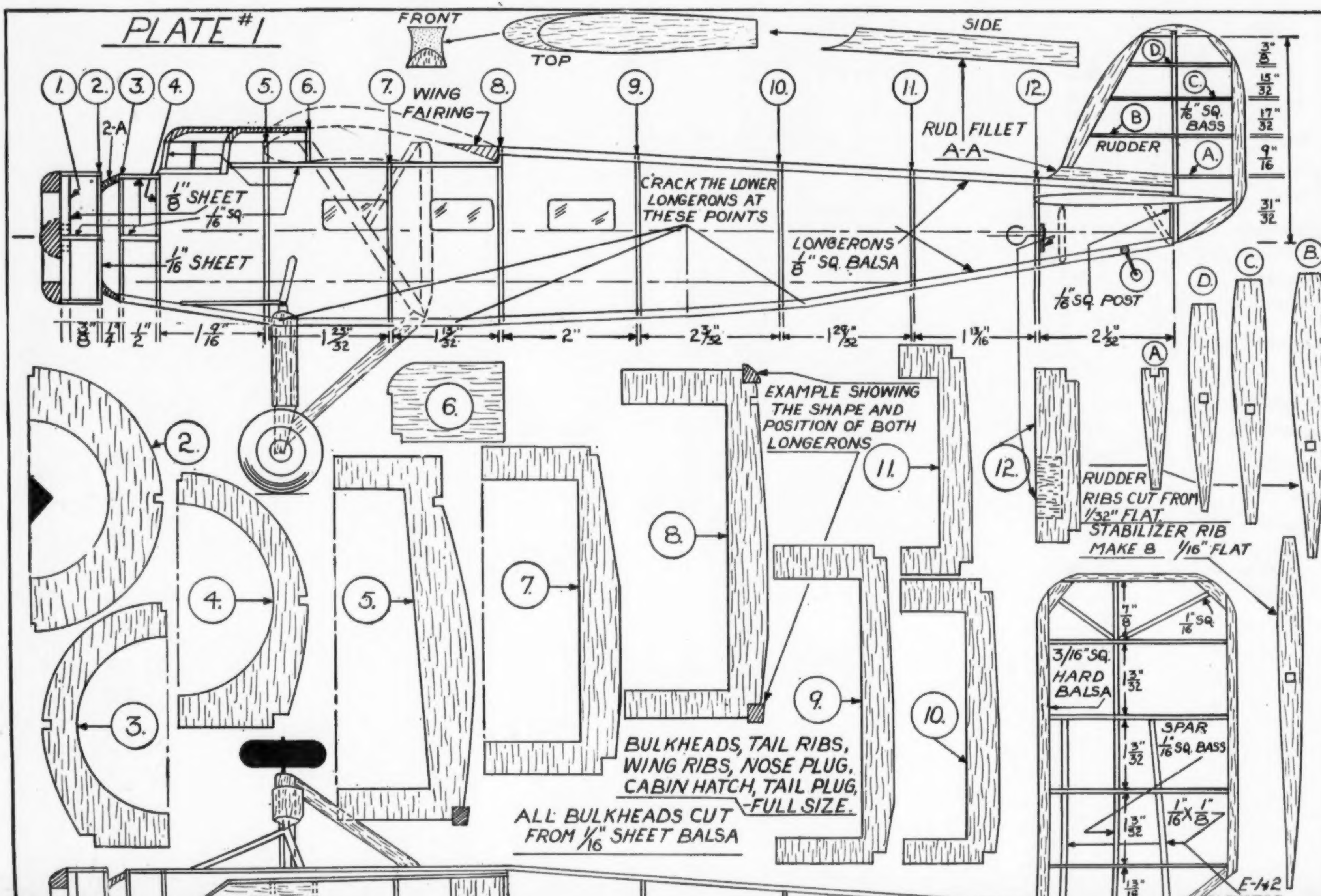
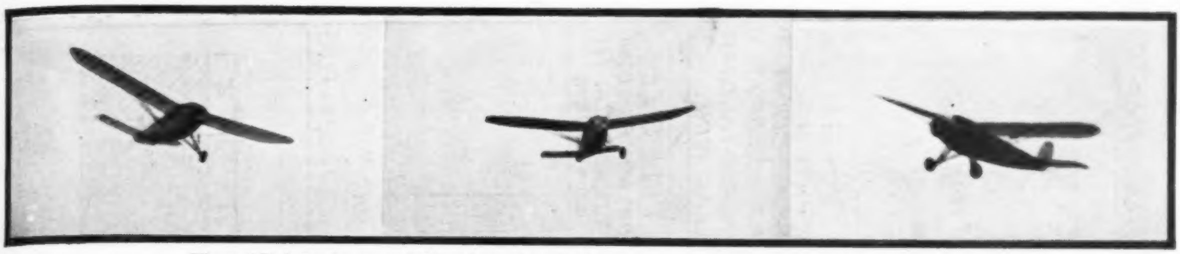


PLATE #1
FRONT
TOP
SIDE
WING FAIRING
2-A
1/8" SHEET
1/16" SQ.
1/16" SHEET
CRACK THE LOWER LONGERONS AT THESE POINTS
LONGERONS 1/8" SQ. BALSA
RUD. FILLET A-A
RUDDER
1/16" SQ. BASS
1/8" SQ. POST
3/8"
1/4"
1/2"
1 9/16"
1 23/32"
1 13/32"
2"
2 3/32"
1 29/32"
1 13/16"
2 1/32"
15/32"
17/32"
9/16"
31/32"
EXAMPLE SHOWING THE SHAPE AND POSITION OF BOTH LONGERONS
RUDDER RIBS CUT FROM 1/32" FLAT
STABILIZER RIB MAKE 8 1/16" FLAT
BULKHEADS, TAIL RIBS, WING RIBS, NOSE PLUG, CABIN HATCH, TAIL PLUG, -FULL SIZE.
ALL BULKHEADS CUT FROM 1/16" SHEET BALSA
7/8"
1/16" SQ.
3/16" SQ. HARD BALSA
1 3/32"
SPAR 1/16" SQ. BASS
1/16" X 1/8"
13/16"
E-1&2 ELEVATOR BRACE STRUTS

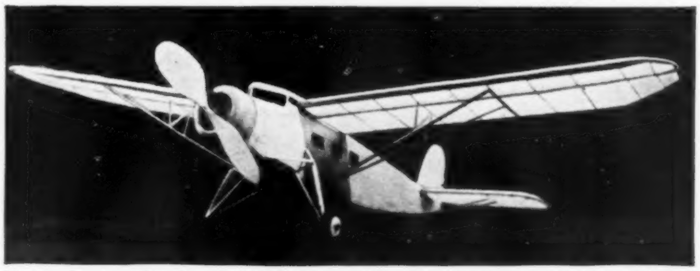


Three "flight" pictures of this plane that disclose its fine stability and realistic appearance

Build and Fly The Fairchild "82"

How You Can Create a Realistic Rugged Scale Model That Embodies Exceptional Qualities For Long Flight Duration

By JESSE DAVIDSON



Here's the completed model. The large wing span, long motor and propeller of ample dimensions insure long flights

INDIANAPOLIS for her annual auto classics; Aberdeen, Dahlgren, Monmouth for their military weapons. . . . proving grounds all. Yet amid the vast and otherwise inaccessible regions of northern Canada lie the *proving grounds for the world's aircraft. . . .*

Not quite a decade had elapsed since the termination of the World War, when Canada actually began to discover her own country. Millions of square miles of wilderness containing enormous natural resources had for years remained virgin. Suddenly this great discovery had taken place; and once it was realized that the airplane could be relied upon, civilization on wings came swiftly to scores of remote areas.

Displacing the old canoe and pack horse, aircraft brought the geologist deep into the interior, making it possible to investigate isolated mineralized areas. To the forester it provided a panorama of millions of acres of developed and maturing woodlands—for Canada is the largest producer of newsprint in the world. And to the topographical engineer it disclosed vast drainage areas, unnamed lakes and rivers, waterfalls and storage sites.

Airplanes increased the mobility of men, money, machinery and material to newly-opened fields of endeavor. Distant and scattered cities were brought days closer. And so Canada, finding the ideal economic use of aircraft, had at the same time found the key to the door opening her vast riches.

When ten years ago the Canadian Government instituted an experimental airmail route it looked about for a type of airplane capable of withstanding severe operating conditions under extreme temperatures; to make frequent landings on ice, snow and water; to operate efficiently after long exposure to the elements due to absence of hangar facilities at outlying bases, and which would prove equally adaptable to the constant changing needs. It was quite a large order to exact from any kind of plane. But the government had not far to look. For just across the border was the very type of plane to fill the specified need. And since then the name of Fairchild has virtually become a household word in the saga of Canadian aviation.

The Fairchild F C-2's with which aerial operations began, exemplified the ruggedness of this great country and through the years has remained prëeminent among aircraft as the ship whose dependability won the confidence and affection that hardy Canadian pilots swear by.

In 1928 it was decided to establish a factory in the Dominion itself due to increasing orders from the Government and independent operators. Financed by $300,000 of Canadian capital and a like sum from the American Fairchild organization, Fairchild Aircraft Ltd. was founded. An entirely self-contained enterprise with a Canadian president and directors, it does its own engineering, manufacturing and sales.

Redesigned and improved but nevertheless characteristically retaining their rugged individualism, Fairchild cabin planes still operate with unfailing stamina —proven thoroughbreds by gruelling years in the proving grounds of the world's aircraft.

For the past two years the Fairchild company has been engaged in the production of a type known as the "82:" A husky, single-motored transport, modern in every detail, it bears semblance to its worthy predecessor, the famous F C-2. The "82" cabin ships are used extensively for freighting between the rail head and mining districts of Northern Canada and quite a fleet are employed in such service. In Mexico, Argentina and Venezuela others are engaged as passenger transports and photographic ships. The necessity for a plane capable of carrying large loads and freedom from maintenance makes the Fairchild "82" a world-wide popular ship.

A description of the Fairchild "82" is as follows:

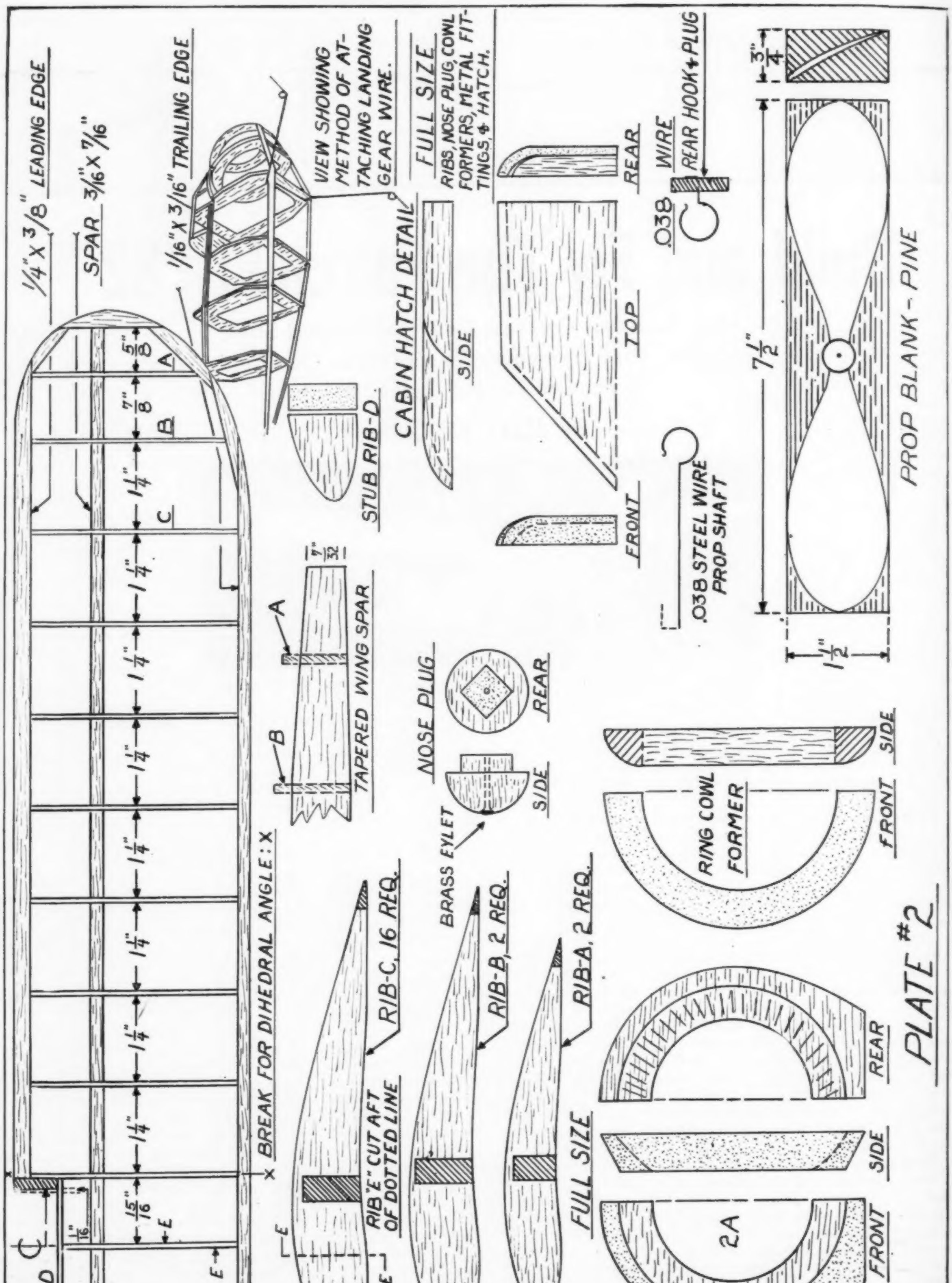
A high-wing cabin monoplane with folding wings, it is easily convertible on floats, wheels or skiis. With a span of 51 feet and powered with a Pratt & Whitney Wasp S3H1 550 HP. engine, it is capable of carrying twelve persons. Propelled by a Hamilton Standard Controllable, the ship takes off fully loaded (land plane) no wind, in 11 seconds. Cruises with 75% power at 141 m.p.h. Top speed with full power is 155 m.p.h. Fuel consumption at 65% power is 25 gallons per hour. Its service ceiling is 17,000 ft. Cruising range fully gassed, at 65% power is 657 miles.

Fuselage Construction

The fuselage bulkheads numbered 3 to 12 inclusive are cut to the full size and shape as illustrated on plate 1. The longerons should be selected from straight grained balsa, 1/8" square cut to the required length. Note that the lower set of longerons must be cracked slightly at the points indicated on the side view drawing. Cement is then applied over these cracks and allowed to harden.

The next step is to cement the aforementioned bulkheads in their respective positions along the lower longerons. The upper longerons are attached starting at bulkhead number 8. Note that the longerons on both the upper and lower part of the bulkheads project outside the bulkheads themselves. This is exemplified by bulkhead number 8. The extreme end of

(Continued on page 50)


1/4" X 3/8" LEADING EDGE
SPAR 3/16" X 7/16
1/16" X 3/16" TRAILING EDGE
VIEW SHOWING METHOD OF ATTACHING LANDING GEAR WIRE.
FULL SIZE
RIBS, NOSE PLUG, COWL FORMERS, METAL FITTINGS, & HATCH.
CABIN HATCH DETAIL
SIDE
TOP
FRONT
REAR
STUB RIB-D
.038 WIRE
REAR HOOK + PLUG
.038 STEEL WIRE PROP SHAFT
PROP BLANK - PINE
7 1/2"
1 1/2"
3/4"
TAPERED WING SPAR
NOSE PLUG
BRASS EYLET
RING COWL FORMER
BREAK FOR DIHEDRAL ANGLE : X
RIB-C, 16 REQ.
RIB "E" CUT AFT OF DOTTED LINE
RIB-B, 2 REQ.
RIB-A, 2 REQ.
FULL SIZE
2A
PLATE #2

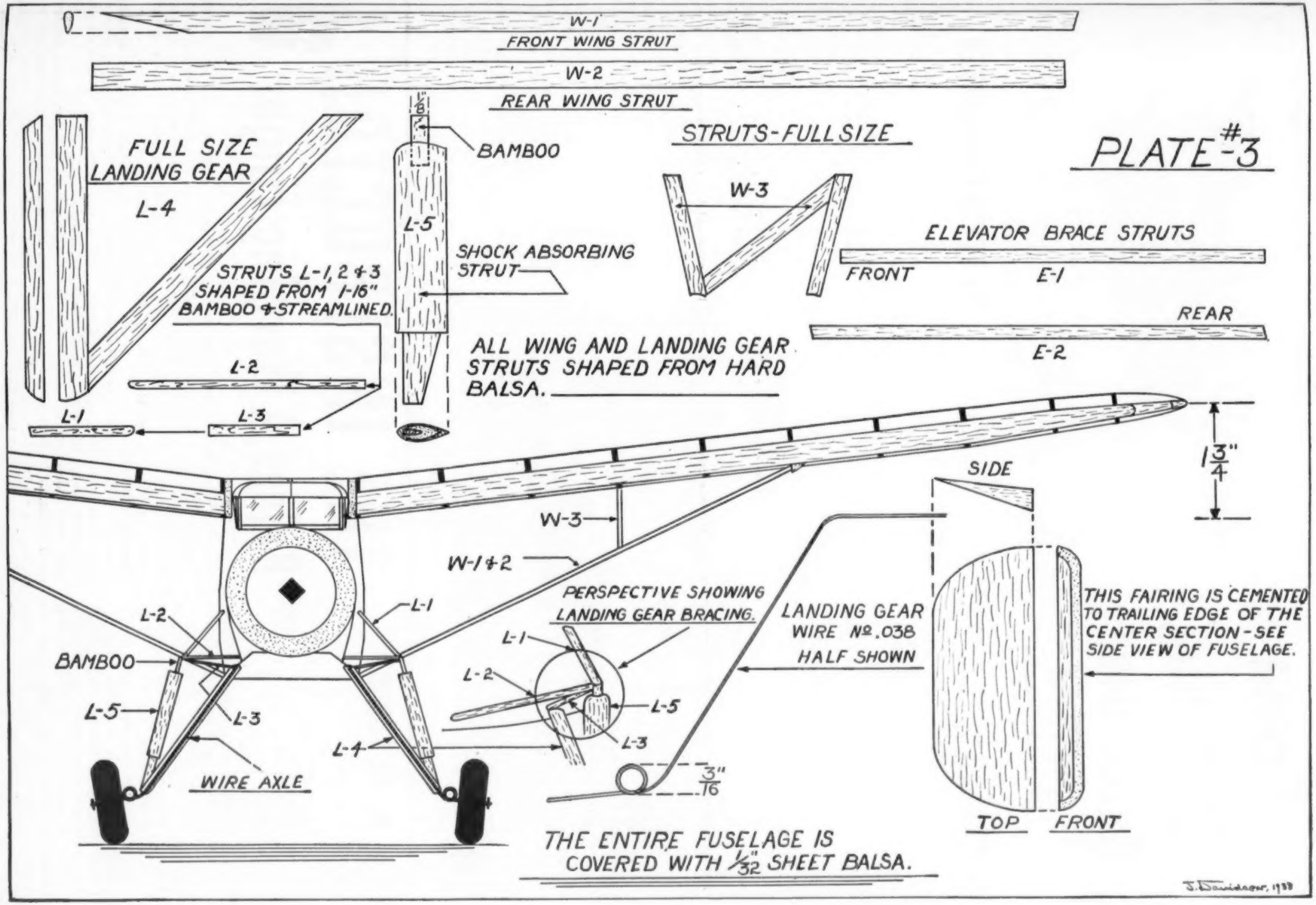


PLATE #-3
W-1
FRONT WING STRUT
W-2
REAR WING STRUT
FULL SIZE
LANDING GEAR
L-4
1/8
BAMBOO
L-5
SHOCK ABSORBING
STRUT
STRUTS L-1, 2 & 3
SHAPED FROM 1-16"
BAMBOO & STREAMLINED.
L-2
L-1
L-3
STRUTS-FULLSIZE
W-3
ELEVATOR BRACE STRUTS
FRONT
E-1
REAR
E-2
ALL WING AND LANDING GEAR
STRUTS SHAPED FROM HARD
BALSA.
1 3/4"
SIDE
W-3
W-1 & 2
PERSPECTIVE SHOWING
LANDING GEAR BRACING.
L-1
L-2
L-5
L-3
L-2
L-1
BAMBOO
L-5
L-3
L-4
WIRE AXLE
LANDING GEAR
WIRE No. .038
HALF SHOWN
3/16"
THIS FAIRING IS CEMENTED
TO TRAILING EDGE OF THE
CENTER SECTION - SEE
SIDE VIEW OF FUSELAGE.
TOP
FRONT
THE ENTIRE FUSELAGE IS
COVERED WITH 1/32" SHEET BALSA.
J. Davidson, 1933

Ocean Spanning Razor Blade

The Plane On The Cover

The Consolidated 31 shaving the air at 275 m.p.h.

By ROBERT McLARREN

HE IS not a tall man. He is thin, suave, now middle-aged. He is an aviation pioneer for he furnished young Donald Douglas with financial backing for his first airplane factory: a tiny room next door to a barber shop in Los Angeles, almost twenty years ago. He was wealthy, young and handsome; but he was never a playboy. And he has made money, lots of it, from his original inheritance; for he is a hard worker, a clear thinker and above all a courageous man. For the courage of David Richard Davis has made this story possible: the story of our Plane on the Cover, the Consolidated Model 31 Flying Boat.

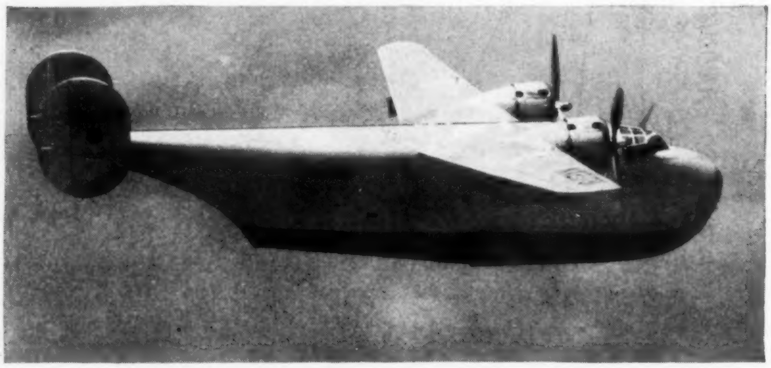
No other single ship in modern aviation history has represented such a complete abandonment of conventionality. As new as the dawning sun which glanced with a dazzling radiance off its sleek metal sides, this astounding sea-going hotel was unveiled a few short weeks ago with the smell of salt sea air from San Diego Bay mingling with the rhythmic staccato bark of the rivet guns at work on another of its kind in the mammoth factory of its birthplace. It is such an unparalled aviation triumph that those of us who witnessed its debut gasped in awed astonishment at first sight of the monsterous yet lithe creation.

David R. Davis had waited ten years for that morning. Years, not of idle anticipation, but a decade of hard, nerve-wracking toil on a formula for a wing section. Aviation needed that set of coordinates, has needed them for a long time. For since Col. V. E. Clark's famous "Y" airfoil was introduced in the middle twenties, few designers have dared use anything which departed too much from its basic principles. But now they need wait no longer for Consolidated has dared to prove that an aerodynamically "perfect" wing is not completely theoretical; it is practical and sensible.

Fundamentally, Davis' wing is a practically perfect wing curve. Its maximum lift is developed at its minimum positive angle of attack which means two things: the wing will fly at a minimum drag and the hull will take off and alight horizontally on the water, not bucking and pitching with its nose high in the air as to-day's seacraft are prone to do.

And what does having this "perfect wing" mean to aviation? Consolidated has answered that question with their twenty-five ton model 31: a greater lifting power

(Continued on page 59)



With its 4000 h.p. it carries 57 passengers and crew

THE INSTRUCTOR Raises A Warning Finger

By AL LEWIS

NOW let's consider the case of some builders . . . first they ponder over the type of ship they'll undertake next . . . then they spend a day, or perhaps a week, thumbing through back issues of MODEL AIRPLANE NEWS to select a keen design—or maybe they purchase one of the many fine kits offered by MODEL AIRPLANE NEWS' advertisers—or design their own plane, basing its proportions and potential performance on data gathered from experience and the proven principles of design found in Mr. Grant's monthly articles . . . then with materials in one hand, plan in the other and a pocketful of dreams which includes winning a championship contest, they commence construction.

Many a patient and enjoyable hour is passed in building the ship—lining up longerons—reinforcing those points which will be subjected to strain—putting everything they have learned into their work. Then too frequently what do these modelers do? Towards the end they speed up "production" in an effort to enter a coming contest, or have the model in the air by Saturday afternoon.

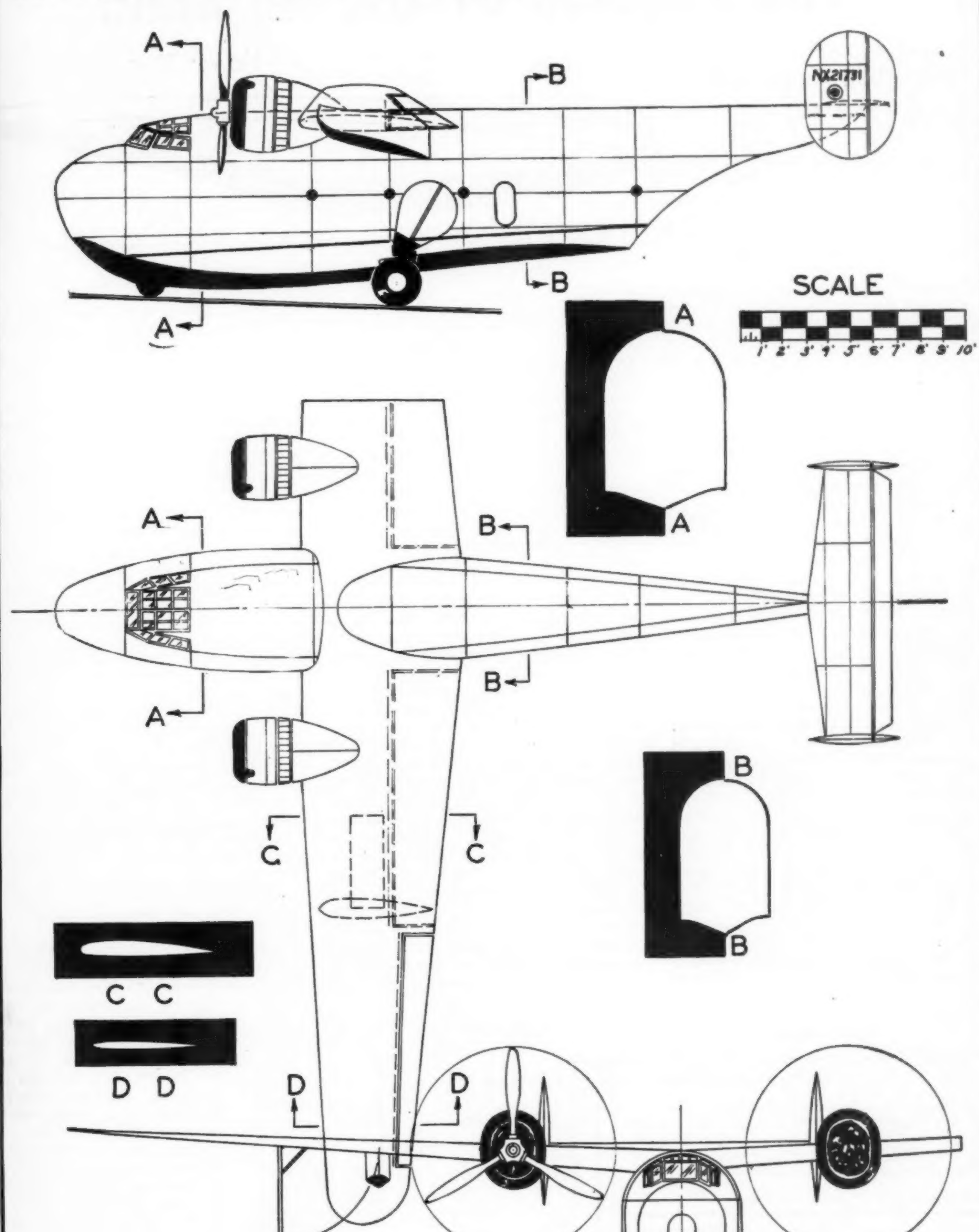
It doesn't make sense: Careful preparations, then too-quick completion. Maybe the builder doesn't take time to inscribe his name and address on the plane—only to stand helplessly by later as it soars out of sight in a thermal . . . or mayhaps those all-too-important test hops were skipped—perhaps the wing was not securely bound to the fuselage. Just overlooking one of those many small details that are so important before getting the ship into the air under full power!

Too many ships crack up because a competent contestant skipped a minor detail or two in his haste to have the plane perform.

Take it easy, will you, chums, and check on all those items? It'll repay you with more winning flights, more all-round

(Continued on page 53)

CONSOLIDATED MYSTERY FLYING BOAT



The Physics of the Airplane

Molecular Forces and Motions

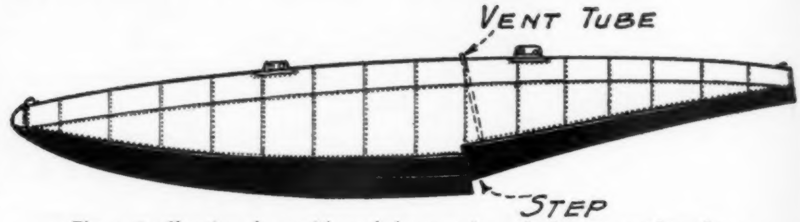


Figure 2. Showing the position of the vent in a single step seaplane float.

By LT. JAMES P. EAMES and WILLIS L. NYE

AN AIR Corps Attack airplane roars upward through a wintry, overcast sky, its Twin Wasp engine bellowing its defiance to the adverse elements. Precipitation, or heavy moisture content, is evidenced by the blackened underside of the pendulous cumulus clouds, bulging and sagging with their weight of water. The attack plane emerges finally into the clear upper atmosphere "on top" and over the overcast. The shiny silver wings are coated with a glistening blanket of hard glazed ice which the efficient de-icers crack off from the leading edge easily. This incident happens frequently in the routine course of cross-country flying. The layman ponders and then asks himself, "What phenomenon has just transpired?" The answer is simple. Merely the change of state of matter; in our case, the transformation of moisture from a liquid into a solid state. The moisture of the clouds becomes solid ice under sufficiently lowered temperature conditions encountered at high altitude.

To review briefly, we recall from the initial article of this series that all matter occurs in one of three states. It may be a solid like ice, or the metals and woods which constitute the airplane structure proper; a liquid like water, chemically coolants or gasoline engine fuel; lastly, it may occur in the form of a gas, like atmosphere which is all about us, or the helium which provides the lifting element for the dirigibles. Whichever of the three forms outlined previously is assumed by matter, it is constituted of very small particles. These particles are termed molecules. In between the molecules constituting a substance are unoccupied spaces. The molecules are not in a state of complete rest, as we would reasonably assume, but are in constant and rapid motion. This condition of molecular motion embraces what may be termed the "kinetic theory." For the sake of accuracy, a further classification of the elements of matter is embodied in the "quanta" theory and the assumption that matter is eventually composed of positive and negative electric charges but such is beyond the scope of this discussion.

The three initial states of matter differ from each other primarily as a result of the variations in the distance of the molecules from each other. For instance, a solid could be defined as "that state of matter in which the molecules cling securely together and tend to maintain their relative position." In a liquid, the molecules tend to cling together, but are free to move with respect to each other. We know this to be true since liquids conform easily to the shape of any container into which they may be poured. Aviation gasoline, for instance, can be transported as easily in a cylindrical tank as in a rectangular tank. However, although liquids do not tend to resist a change in shape, they do quite definitely resist any change in their volumes. In other words, liquids do not respond to compression. Gases, on the other hand, differ radically from solids and liquids in that their molecules are free to move about freely without restraint. For instance, in order to obtain the requisite compression for subsequent expansion and power in an aircraft internal combustion engine, the liquid gasoline must be mixed with atmospheric air in suitable proportions in order to effect the transformation to the gaseous state. Only then can it be compressed. Thus it can be readily understood that gaseous molecules tend to separate indefinitely. Gases do not at all resist forces which tend to change their shape and only to a small degree do they resist forces which tend to change their volume. This is so because the inherent inertia of a gas is less to a considerable degree than a liquid.

The reasons for believing that matter, in any or all of its states, is made up of molecules which are in a constant state of motion are all predicated upon the observed behavior of gases. The property of rapid expansion into a free space is alone ample proof of rapid molecular motion in a gas. A good example of this is found in the operating cycle of a modern high speed aircraft gasoline engine. The inlet valve presents an extremely narrow opening for only a very small fraction of a second. Yet, this brief period suffices for the combustible mixture of gasoline and atmospheric air to enter, attain a high degree of saturation and interchangeability of the molecules and completely fill the combustion chamber of the cylinder. In fact, the velocity of gases in an internal combustion engine attains velocities which are difficult for the layman to comprehend. Yet, this cycle of events in a gasoline engine takes place every time the engine is operated, and does so intermittently over long periods of hours.

Some examples will be of interest in this connection. For the sake of illustration, when a difference of pressure exists between the carburetor and the inlet valve, of one pound per square inch, the gas will attain a velocity of 320 feet per second. For the sake of efficiency, the gas velocity should not vary much from a range of 250 to 300 feet per second. In conventional aero engines, the gas vapor velocity ranges from 116 f.p.s. through the inlet valve port, 300 f.p.s. in the carburetor choke tube and approximately 170 f.p.s. through the exhaust port. The figures given above are derived from empirical equations and various engines, of course, may show various figures, all in accordance with the design of the engine. All gases

(Continued on page 47)

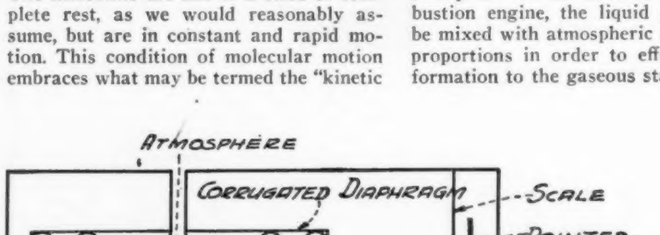


Figure 3. Schematic diagram of a rate or climb indicator.

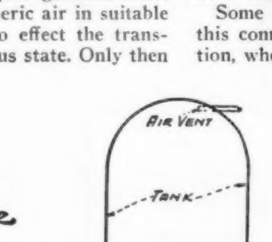


Figure 1. Simple moisture trap in a gasoline tank.

1939 "NATIONALS" WINNERS

OUTDOOR CABIN CONTEST

Admiral Moffett Eliminations
Jr.-Sr. Age Div.

Robt. Toft	19	Minneapolis, Minn.	765.33	Stout Perpetual Trophy Peerless Model Airpl. Tr.
Geo. Reich	18	Cleveland, Ohio	515.53	Fleetwings Trophy
Edward Naudzius	20	Detroit, Mich.	444.73	Scient. Mercury & Xch. Cl.
Walter Dickinson	20	Newark, N. J.	440.46	Starliner and Xch. Cl.
Robt. Lichten	17	Philadelphia, Pa.	439.53	Exchange Club Award
Earl Stahl	20	Johnstown, Pa.	392.46	Exchange Club Award
Robt. Romeisen	15	Indianapolis, Ind.	352.66	Exchange Club Award
Lawrence Cowell	15	Pontiac, Mich.	308.06	Exchange Club Award
Jos. Vermoch	20	Chicago, Ill.	300.40	Exchange Club Award
Abraham Adler	17	Philadelphia, Pa.	294.66	Exchange Club Award
Ervin Leshner	20	Philadelphia, Pa.	285.20	Comet Award
Ted Just	17	Johnstown, Pa.	261.06	Comet Award
Rodney Streed	19	Waukegan, Ill.	241.13	Socony Vacuum Medal
Arthur Koslow	18	Perth Amboy, N. J.	227.20	Socony Vacuum Medal
Gilbert Shurman	17	New York City	215.33	Socony Vacuum Medal

OPEN AGE DIV.

V. C. Davis	24	Houston, Texas	527.13	Guillow Award
Kenwood Carter	29	1017 Maynor, Nashville, Tenn.	503.73	OK Mtr. & Xch. Pl.
Kenneth Carpenter	21	Akron, Ohio	294.46	Starliner Xch. Pl.
Robert Redder	21	Chicago, Ill.	262.00	
Henry Thomas	23	1353 Grant, Akron, Ohio	204.80	Xch. Cl. Awd.
Henry Struck	22	1917 Roosevelt, Jack. Hghts., L. I.	185.60	Xch. Cl. Awd.
Dick Korda	24	Cleveland, Ohio	183.53	Xch. Cl. Awd.
Stephen Thomas	23	Akron, Ohio	176.06	Xch. Cl. Awd.
Frank Plachy	23	Chicago, Ill.	160.60	Xch. Cl. Awd.
Steve Herchick	21	Bridgeport, Conn.	134.26	Comet Award
M. W. Anderson	21	Staten Island, N. Y.	133.80	Comet Award
Dick Everett	21	Elm Grove, W. Va.	123.00	Soc. Vac. Medal
Curtiss Janke	23	Sheboygan, Wis.	122.66	Soc. Vac. Medal
Leo Bailey	21	Akron, Ohio	122.53	Soc. Vac. Medal.
Robt. Redder	21	Chicago, Ill.	118.66	Soc. Vac. Medal

WAKEFIELD INTERNATIONAL CONTEST ELIMINATIONS

Open

Dick Korda	24	Cleveland	263.66	Mechanix Illustrated Cup
James Cahill	21	Indianapolis	180.66	Syncro Ace Engine & Ex. Medal
Fred Mees	24	Columbus	156.46	Comet Award
Jas. Noonan	22	Milwaukee	141.33	Comet Award
Walter March	21	Chicago	116.33	Comet Award
John Kubilis	21	Chicago	114.06	Comet Award
Conrad Renning	28	Minneapolis	106.06	Comet Award
H. Thomas, Jr.	23	Akron, Ohio	89.66	Metro. Exch. Cncl. Medal
Magnus Anderson	21	Staten Island	87.40	Metro. Exch. Cncl. Medal
Henry Struck	22	Jackson Hghts.	85.00	Metro. Exch. Cncl. Medal

WAKEFIELD INTERNATIONAL CONTEST ELIMINATIONS—JR. AND SR.

R. Gene Chaille	16	Miami	489.20	Peerless Model Co. Trophy
Jack Thames	18	Pittsburgh	394.33	Fairchild Engine & Airplane Cup
James Bohash	20	Detroit	275.66	Syncro Bee Engine & Ex. Medal
Arthur Beckington	16	Rockford	213.46	Comadore Kit & Exchange Medal
Earl Stahl	20	Johnstown	190.60	Xacto Knife & Exchange Medal
Alvie Dague, Jr.	19	Tulsa	170.93	Xacto Knife
George Johnson	17	Minneapolis	167.60	Xacto Knife
Ed. Lingard	20	Chicago	165.26	Comet Award
Ray Beaumont	15	Philadelphia	160.40	Comet Award
Tony Carrara	19	Cincinnati	141.46	Comet Award
Walter Seemiller	16	Lakeland	112.53	Comet Award
Harvey Prochnow	18	St. Paul	106.80	Metro. Ex. Club Medal

RADIO CONTROLLED POWER MODEL EVENT

$100	Walter Good	89 Points	Ed. Roberts Trophy
50	Joe Raspanti	11 Points	General Battery Trophy
30	Elmer Wasman	9 Points	R.C.A.
15	Phillip Sonheim	8 Points	Burgess Battery
15	C. H. Siegfried	8 Points	Baby Cyclone Engine
15	Robt. Mende	8 Points	
15	Ervin Leshner	8 Points	
10	Jesse Bieberman	6 Points	
	Howard Flanigan	1 Point	
	Chester Lanzo	1 Point	
	Robt. Rose	0 Point	

All radio contestants receive Metropolitan Council Exchange Club Plaque.

Model America at the Nationals

(Continued from page 9)

and the sun transformed pale complexions to a more rugged hue. Model builders occupied their attention on this day with the Wakefield Eliminations, the Moffett Finals and the Outdoor Flying Scale Model Event.

One of the outstanding features of Thursday's activities was the radio-controlled power model flight made by Walter Good and his brother, Bill. Walter had his model flying over the airport, making right and left turns, figure 8's, downwind and upwind flights, and finally, after a leisurely flight in the direction of the big hangar, the model was brought back to within 100 feet of the starting point and landed with great precision. This was historical, for it was the first radio-controlled power flight ever to take place at a national contest, in which the radio control element was clearly demonstrated. Later in the day Joe Raspanti, with a beautiful ten foot red cabin job made another radio-control flight. Raspanti's flight was excellent and demonstrated complete control up to a point where another radio contestant interrupted Raspanti's control of his model by a practice operation on his radio transmitter. . Of course the contestant did not intentionally interfere with the radio plane's operation, but these receivers at present are extremely sensitive and when anyone else operates their transmitter it is nearly impossible to retain control from another transmitter, especially when the ship is a considerable distance from the radio operator. The unintentional interference caused the motor of Raspanti's ship to shut off, and the plane landed while in the act of making a figure 8. It landed safely however and no damage was done. This was one of the factors which prevented him from giving as fine a demonstration as the Good brothers. However he would have had to extend himself considerably in order to equal the show put on by Walter and Bill.

A few contestants with an eye for the coming two days of the meet, tested their gas jobs and made adjustments so that they might not be delayed in their official gas model flights which were scheduled for Friday and Saturday.

On Friday the indoor events were held at the Grosse Ile Airship Dock. Record times were not made. However winners staged flights of over fourteen minutes in both the Stick and Indoor Cabin Events. In the Indoor Stick Event Ed Naudzius of Detroit flew his ship for 17.51 3/5 minutes.

At the Wayne County Airport, where the outdoor events were held, the Gas Models took the air. Unfortunately the field officials prohibited the use of the concrete runways, apparently still failing to realize the importance of the scientific educational work being carried on through model airplane activities. It seems some of the "grown ups" have not developed to maturity sufficiently to realize that these little ships are not being used as toys. The manager of the airport, Mr. Henry Baker, did everything within his power to facilitate the smooth running of the contest and to supply the necessary equipment. However, the Department of Commerce and army regulations were too well tied up with red tape to insure the necessary freedom of activity for

(Continued on page 55)

AMERICAN WAKEFIELD INTERNATIONAL COMPETITION TEAM

Robert C. Chaille	16	Miami	8:09.2	Exchange Club Award
Jack Thames	18	Pittsburgh	6:34.3	Exchange Club Award
James Bohash	20	Detroit	4:35.7	Exchange Club Award
Dick Korda	24	Cleveland	4:33.7	Exchange Club Award
James Cahill	21	Indianapolis	Winner of Wakefield contest in Paris last August	Ex. Medal
Ralph Baker	17	Santa Ana, Cal.	Winner of the West Coast Elimination	Ex. Model

AMERICAN MOFFETT INTERNATIONAL COMPETITION TEAM

Edward J. Naudzius	20	Detroit, Detroit Chapter N.A.A.	186.00	Exch. Club Cncl. Awd.
Geo. Reich	18	Cleveland, Cleveland Balsa Butch	147.66	Exch. Club Cncl. Awd.
Robt. Toft	19	Minneapolis, Minn., Minn. Model Aero Club	110.13	Exch. Club Cncl. Awd.
Walter Dickinson	20	Newark, N. J., Kresge Aero Club	98.73	Exch. Club Cncl. Awd.
V. C. Davis, Jr.	24	Houston, Tex., Houston Miniature A.	60.06	Exch. Club Cncl. Awd.
Kenwood Carter	29	Nashville, Nashville Aero Club	58.20	Exch. Club Cncl. Awd.
Robt. Lichten	17	Phila., Quaker City M.A.A.	439.53	Exch. Club Cncl. Awd.

CANADIAN MOFFETT TEAM

Lavelle Walters	27	Windsor, Ont., Can.	93.93	Exch. Club Cncl. Awd.
Robt. Milligan	18	Toronto, Ont., Can.	66.73	Exch. Club Cncl. Awd.
Jeff Harris	23	Toronto, Ont., Can.	51.06	Exch. Club Cncl. Awd.
Roy Nelder	18	Toronto, Ont., Can.	49.06	Exch. Club Cncl. Awd.
Charles Fairfield	16	Toronto, Ont., Can.	34.66	Exch. Club Cncl. Awd.
Harry Lucas	15	Toronto, Ont., Can.	30.06	Exch. Club Cncl. Awd.

MOFFETT INTERNATIONAL COMPETITION WINNER & RUNNERS-UP

Richard Naudzius	20	Detroit	3:02	IMP. Prop Clock. Moffett Trophy
Geo. Reich	19	Cleveland	2:09.2	
Robt. Toft	19	Minneapolis	1:16.7	
Walter Dickinson	20	Newark, N. J.	1:12.9	
Lavelle Walters	27	Windsor, Ont.	1:11.3	
Robt. Milligan	18	Toronto, Ont.	1:00.9	

OUTDOOR FLYING SCALE MODEL CONTEST

Open Age Class

		Wrkship and Fid.	*Flt. Pts.*	*Total Score*	*Joy Cash Award*	
Henry Thomas, Akron, Ohio	23	39.25	30	69.25	$25	Thos. Bourne Joy *Memorial Trophy* Exchg. Council Awrd.
Henry Struck, New York City	22	42.75	25.85	68.60	$20	Exchg. Council Awrd.
John Ogilvie, New York City	22	42.75	24.94	67.69	$15	Exchg. Council Awrd.
Herbert Wise, Akron, Ohio	21	25	27.37	52.37	$10	Exchg. Council Awrd.
Jas. Noonan, Milwaukee, Wis.	22	38	6.40	32.40	$ 5	Exchg. Council Awrd.

Jr.-Sr. Age Class

Roger Hammer, Newark, N. J.	18	35.75	24.63	60.38		Wm. O'Neil Trophy & Gas Eng. Exchg. Council Awrd.
Anthony Kaslouskas, Akron, Ohio	18			60.28	12.50	Exchg. Council Awrd.
Rancel Hill, Akron, Ohio	18	24.50	30	54.50	7.50	Exchg. Council Awrd.
Ted Just, Johnstown, Pa.	17	28.25	24.53	52.78	5.00	Exchg. Council Awrd.
Martin Phillips, Boston, Mass.	15	28.75	5.24	33.99		Exchg. Council Awrd.
Harry Lerman, Boston, Mass.	17	27.	5.95	32.95		Exchg. Council Awrd.
Wm. Hammer, Milwaukee, Wis.	17			27.75		Exchg. Council Awrd.
Leonard Baer	15			11.75		Exchg. Council Awrd.
Leon Kortas	16					Exchg. Council Awrd.

INDOOR STICK

Jr.-Sr.

Ed. Naudzius	20	Detroit	17.51 3/5	Stout Trophy C. A. Campbell Solventol Cronogran
Alvie Dague, Jr.	19	Tulsa	17.29 1/3	Torpedo Engine, Ex. Pl.
John Stokes	18	Huntington Valley	17.07 1/3	Syncro Saw, Ex. Pla.
Milton Huguelet	17	Chicago	16.09	Camera, Xacto & Pla.
Robert Jacobsen	19	Philadelphia	15.08	Ex. Pla.
Ted Just	17	Johnstown	15.04 1/3	Ex. Pla.
Gilbert Shurman	17	New York City	14.35 1/2	Ex. Pla.
Charles Belsky	20	Chicago	14.33 1/5	Ex. Pla.
Wilfred Bobier	15	Detroit	14.10	Ex. Pla.

A CLEAN SWEEP at the world's biggest meet

1ST PLACE $100.00 JOHN BUNCH 20 min. 20 sec.

3RD PLACE $25.00 HOWARD BROUGHTON 13 min. 9 sec.

5TH PLACE 1st CHOICE Merchandise Award JIM WILLIAMS, SR. 12 min. 30 sec.

CONTEST DIRECTOR NOTES BUNCH MOTOR RECORDS

BUNCH MOTORS WIN

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When you buy your next engine remember the self-styled champions of the past are not good enough. Bunch Motors, of modern construction, deliver that extra performance, needed stamina and rugged dependability that is winning to-day!

★ NOTE:—*The Bakersfield contest was held under the new limited motor run rules. Bunch and other regular size engines were required to fly under a 12 oz. per sq. ft. minimum weight loading. This handicap did NOT apply to small bore engines in the same competition.*

Frank Knapton, leading N.A.A. official at all Pacific Coast meets says: *"The competition at the 1939 Bakersfield meet was the ACID TEST for champions! With all the experts striving to win the large cash prizes, competition was the keenest I've seen. The first 8 official times above 10 minutes would win any other like contest."*

Bunch Motors HAVE THAT something extra to outperform and win 3 leading places in the West's latest, greatest contest.

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All Bunch Engines are piston ring equipped. H.P. 1/5 - Bore 7/8 - Stroke 3/4 - Displacement 45/100 cu. in. Assembled engines fully blocktested. Engine kits supplied with all bearings, piston and rings and timer fitted. Includes coil, tank, condenser.

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Gwin Aero Inverted Kit	9.85	☐
Mighty Midget Upright Assembled	9.50	☐
Mighty Midget Inverted Assembled	9.75	☐
Mighty Midget Upright Kit	7.85	☐
Mighty Midget Inverted Kit	7.85	☐
Mighty Marine Speedboat Engine	12.50	☐
Mighty Marine Engine Kit	10.85	☐

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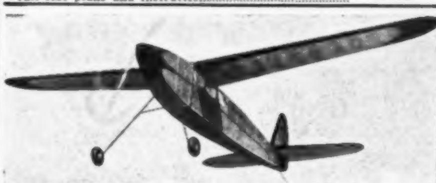

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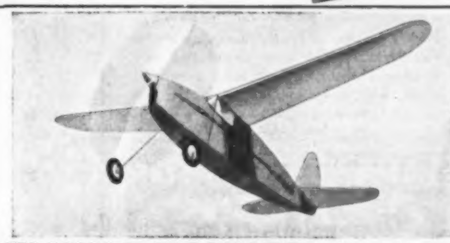

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...kit with balsa wheels containing hard-... (in place of M & M wheels) post-... less motor only........ **$3.50**

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Matthew Smith	18	Washington, D. C.	14.05	Ex. Pla.
Jordon E. Cain	19	Hyde Park	13.48	Ex. Pla.
William Hawks	17	Philadelphia	13.06	Ex. Pla.
Bob Christie	19	Tulsa	11.36	Comet Award
Edward Swenton	18	Syracuse	10.29	Comet Award
Joseph V. Boyle, Jr.	20	Coraopolis	10.18	Metro. Ex. Council Med.

INDOOR CABIN

Open

Joseph Matulis	26	Chicago	10.55	Fafnir Bearing
Andrew Petersen	24	Los Angeles	10.24	OK. Motor & Xch.Cl.Awd.
James Cahill	21	Indianapolis	8.37	Midwest Voucher & Awd.
Merrick S. Andrews	25	Philadelphia	5.26	Xchg. Cl. Plaque
Roy Wriston	25	Tulsa	4.13	Xchg. Cl. Plaque
Ed. Fulmer	23	McKees Rocks	4.11	Comet Plaque
T. Jeff Harris	23	Toronto, Ont.	3.35	Comet Plaque

INDOOR STICK

Open

Ed. Fulmer	23	McKees Rocks	14.34 3/5	Springfield and Flying Aces Mag. Trophy
Merrick S. Andrews	25	Philadelphia	14.32 2/5	Trost Model Shop
Andrew Petersen	24	Los Angeles	13.31	Midwest Voucher, Ex. Pl.
James Cahill	21	Indianapolis	13.31	Pla. Camera, Xacto Knife Set
Joseph Matulis	26	Chicago	12.52	Ex. Pla.
Geo T. Bailey	21	Akron	10.59	Ex. Pla.
Ed. Levy	21	St. Louis	10.54	Ex. Pla.
Roger Hammer	21	Newark	10.47	Comet Award
Jesse Bieberman	34	Philadelphia	10.38	Comet Award
John Zaic	25	New York City	10.34	Shinn Devices Medal

INDOOR CABIN

Senior

John Stokes	18	Huntington Valley	14.12	Bloomingdale Tr.& Miniat.
Stanley Stanwick	17	Boston	12.17	No. Amer. Aviation Trop.
Harry Lerman	17	Boston	11.25	Torpedo Eng.& Xch.Cl.Pl.
Matthew Smith	17	Washington, D. C.	11.17	Xch. Cl. Plaque
Ted Just	17	Johnstown	9.58	Xch. Cl. Plaque
Maurice V. Arnold	20	Columbus	6.51	Xch. Cl. Plaque
Olvie Dague, Jr.	19	Tulsa	6.35	Xch. Cl. Plaque
Walter Hartung	19	Detroit	6.00	Xch. Cl. Plaque
Irwin Leshner	20	Philadelphia	4.26	Xch. Cl. Plaque
Ralph W. Brown	17	Boston	3.46	Xch. Cl. Plaque

BERRYLOYD FINISH CONTEST

C. H. Siegfried	Wichita, Kan.	Berryloyd "Airplane" Trophy
Michael J. Roll	Detroit, Mich.	Small Berryloyd "Airplane" Trophy
Joe Raspanti	Brooklyn, N. Y.	Small Berryloyd "Airplane" Trophy

POWER MODEL CONTEST

Class "A" Jr.-Sr.

John Findra	17	New Brunswick	66.86	Comet Model Trophy
Leon Shulman	18	Brooklyn	28.83	Dallaire Trophy
Arthur Block	17	New York City	23.53	Berkley Tro. & Cyclone Eng.
Howard Melin	18	Galesburg	20.46	Aero Coil Exchange Award

POWER MODEL CONTEST

Class "A" Open

Frank Young	24	Lansing, Mich.	7.06	Bar Aviation Trophy
Chas. Guarnieri	23	New York City	1.40	Exch. Awd. & Ever Ready Flash

(Continued on page 56)

CAPT. JOHNNY JONES

Famous American Airlines Pilot and holder of the Trans-continental Non-Stop Light Airplane Record . . . is sponsoring the GREAT *Virginia House* MODEL AIRPLANE CONTEST, and wants you to win one of these genuine *Virginia House* Maple beds.

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This is not a national . . . but is purely a local contest . . . will be judged by local airplane authorities . . . which means that you have a better chance than ever of winning. A beautiful "Virginia Flagship" bed will be given away in each town and city where the contest is conducted.

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Frontiers of Aviation

(Continued from page 15)

has not as yet burned up or done any of the other extraordinary things that the "Maid" did in its very smoky lifetime. Capt. V. H. Baker's and Mr. J. Martin's future depends to a great extent on the success of their new enterprise and thus they have taken much care and precaution in the design of this airplane.

The Martin-Baker is a low-wing, full cantilever monoplane with a rigid landing gear that brings back the days of the first Northrops, the Seversky trainers and of course the Delgado. Like the Delgado too is the wing with very little dihedral but of thick chord and short span. As a matter of fact the fuselage is slightly longer than the span. The main feature of this was that with added length to the fuselage enough longitudinal stability would be obtained so as to eliminate the fin, but like most brain storms this idea did not work. Now the plane has a conventional tail and has to carry all that extra fuselage around with it for trying to "go radical."

In the nose is one of those "H" type Napier Dagger 24-cylinder, 1,000 hp. engines which gives a small frontal area and adds to the plane's credit. Undoubtedly the airplane really gets up and goes on the straight-away, but its stub wing tips, which for some reason have also found an existance in this country, prevent the pilot from flying too fast. The oil cooling radiator is located in the leading edge of the landing gear fairing on the left side.

Construction consists of a fuselage of steel tubing partly metal and fabric covered and the wing is steel with dural covering. The ship is fitted with several guns and may be able to hold its own, but before passing further judgment we will wait to hear what the Air Ministry thinks of it.

Clarence McArthur, who was the former pilot of the "Delgado Maid," was unfortunately killed recently when he was forced to jump from a hotel window during a fire, and thus we lose another of the more famous racing pilots.

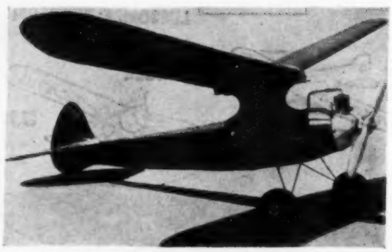
The month of June which passed not so long ago was a very busy one as far as the airplane designer was concerned, for he had to complete all his designs before July rolled around to enter them in the many competitions that took place that month. There being no finished airplane required to accompany the bid, the various companies spared little conservatism and went "pell mell" into every type of plane called for by the Army Air Corps. Most of the major companies entered at least six of the competitions and we would not be surprised if Douglas entered all of them! Without the enormous expense of building experimental planes the companies were in a position to hire many more engineers and since they did not have to go into the construction of the plane immediately, they were able to put more originality into their designs than is often the custom. The army engineers will have more than one headache deciding who shall get the various contracts in trainers, basic combats, pursuit-interceptors, light and heavy bombers, attack-bombers, observation planes and fighters, for the planes will be closely matched. Frontal areas will be cut down to very slim margins and speeds will be way above any yet produced in this country. Radial engines, for example, will be completely enclosed. We may see the evolution of the retractable pilot's enclosure for long distance flying on instruments, the use of engine nacelles for storing bombs, the use of four-bladed propellers and the almost complete dominance of the high- or gull-winged airplane and the high mid-wing airplane. All the new flaps and other safety devices will be used. Every new idea that the airplane designer has created in the last few years will be down on paper as the Army Air Corps delves into the mass.

With this new method of contracting for aircraft the manufacturer has taken the attitude that anything that looks like it will work on paper is good enough to enter in the competition and when he gets the order it is then time to worry about its practical application and the production details of the airplane. Let us hope these design features work out in practice as well as they do in theory or otherwise it will be the essence of confusion among the Army Air Corps and the manufacturing moguls.

While on the subject of the design of the airplane in general we bring you words on its tail. For the past year our prominent tail engineers must have been standing on

SAY FELLOWS:
FOR MANY MONTHS A BATTLE HAS BEEN RAGING BETWEEN MODELCRAFT AND GRAVITY AND IT LOOKS LIKE MODELCRAFT HAS WON. HERE IS THE RESULT- *THE MODELCRAFT INTERCEPTER*, FASTEST CLIMBER OF THEM ALL! UNDESIRABLE CHARACTERISTICS COMMON IN ALL MODELS OF THIS TYPE HAVE PREVENTED US FROM RELEASING IT SOONER-BUT WHEN MODELCRAFT ENGINEERS ADAPTED OUR NEW STABLE AIRFOIL, WE ELIMINATED THE TENDENCY TO PORPOISE ALL OVER THE SKY. BE CAREFUL WHEN YOU FLY YOUR NEW *INTERCEPTER*, SHE'S A FAST CLIMBER, BETTER TAKE ALONG THE FAMILY SHOT GUN IF YOU WANT TO GET IT DOWN AGAIN. YOU'LL THINK YOUR SHIP HAS CAUGHT THAT PROVERBIAL SKY HOOK MODEL BUILDERS HAVE BEEN TALKING ABOUT.

Barney



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their heads or have been afflicted with an epidemic of surrealism, for even the French designers have not been able to create such abortions. We have in mind such planes as the new Boeing Clippers, the Consolidated Model 31 that was just completed, a couple of those attack-bombers that entered the last competition and last but not least the DC-4.

As far as the tail on the Consolidated is concerned, it may just be a matter of taste for undoubtedly it does work efficiently and we have heard many designers that do not work at Consolidated say they like the tail, mind you. It is undoubtedly simple to manufacture and its stub tips have aerodynamic merit, but nevertheless we think great improvements could be made in its design to coincide with the very clean lines of the rest of the airplane. As for the other ships with their tails we will just mark them down as sad cases. For a beautiful ship that proudly thrusts her nose through the air and flies so gracefully as does the Douglas DC-4 it is a shame that it is made to cart all that mess of superstructure around with it.

The multi-rudder tail offers many possibilities for efficient and graceful designing, and it is unfortunate that the American designers have murdered its good features. With anticipation we wait to see the forthcoming military ships remedy this trend.

Stinson surprised the world when it gained a large order for observation planes from the U.S. Army Air Corps to make the company a prominent warplane builder overnight. The contract totaled $1,500,000 for an unspecified number of airplanes. Two of its competitors, Bellanca and Ryan, received $50,000 each for honorable mention. The Stinson airplane is an entirely new design that the company has been working on for some time. It is said that the airplane is of the short-range observation type especially adaptable for work with infantry units.

Other prominent sportplane manufacturers that have already begun to reap harvest from the present armament program are Waco, St. Louis Car Co., and again Ryan is mentioned. This time it was for trainers with orders for about thirteen ships going to each with an additional thirteen probable in the near future. This new plane of Waco's we hear still retains the biplane feature. The St. Louis Company has spent many years with the thought that it might get a military contract and details of their airplane should be interesting when disclosed. Ryan won her share with a slightly revamped version of its ST low-winged ship.

We made it rather obvious in past issues that we liked the Douglas twin-engined attack-bomber very much and it was good news when we heard that Douglas won the competition against such competitors as Martin, Stearman and North American. It was somewhat of a surprise when they copped the $15,000,000 order after it had been thought that they were eliminated by the crack-up of their plane. However we think the Air Corps picked the right airplane and we are now awaiting to see the first of the planes come out the doors of the new huge assembly building just completed at Douglas's El Segundo plant. (The big surprise may be though that it will come out the doors of the Douglas Santa Monica Division, for the former Northrop plant in El Segundo may have enough to do in building experimental planes. We hear Douglas has a small single-place fighter in the completion stage.

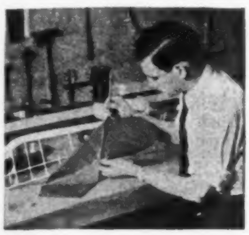
According to Secretary of War Johnson, the new Seversky YP-43, of which thirteen are now being built, will do over 350 m.p.h. The order totals $974,324. Major Seversky has resigned from the company bearing his name, and thus we may see a new trend in design of Seversky aircraft with a new chief engineer at the helm.

North American Aviation, Inc., came out victorious in a competition for basic combat ships in which Vultee placed a close second. North American's entry is a much advanced design over its former BC-1 and is practically identical to the BC-2 type that has been delivered to the Army Air Corps. Vultee's airplane is small but of the same general design. It is of all-metal construction, and Vultee had felt rather certain, we hear, of winning. North American's contract amounted to about $2,500,000 for approximately 100 planes and Vultee's amounted to $90,000 to pay for experimental costs and the purchase of test ships. Vultee at the present moment has high hopes of establishing a record backlog by way of the July army competitions. They have hired very many engineers and are at work on several "super" designs.

It was only a lapse of ten months from the time that the Consolidated Model 31 was originated to the time when the first test ship took off on its maiden hop. The Model 31 is Consolidated's latest twin-engined flyingboat, and it boasts of a gross weight of 25 tons. The wing loading figures close to 45 lb./sq. ft. Douglas's little twin-engined attack bomber has a wing loading of 30 lb./sq. ft. which was considered the highest of any airplane in production.

The Fowler flap was first made popular by Martin without much success until Lockheed picked it up and designed the Model 14. The success that Lockheed has had with them and that which Consolidated undoubtedly will have may entice more manufacturers to use them. The flaps on the Model 31 are hydraulically operated.

With so many new, original and exclusive ideas coming out of the Megow Research Department lately, an entirely new and different type of gas model has been designed to use them. The result: two amazingly strong, extremely light models that can be built in a few hours . . . the COMMANDER and the CADET.



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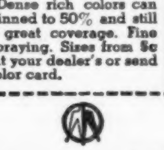

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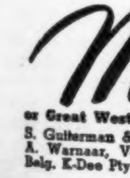

Same as used on big planes. Fine quality, brilliant, smooth-flowing, quick-drying. Dense rich colors can be thinned to 50% and still have great coverage. Fine for spraying. Sizes from 5c up. At your dealer's or send for color card.

Models like these can be built only with Megow kits. Without Megow's hollow-carved and finished Leading Edge and structural design, even the most expert builder working many days could scarcely build a wing half so strong and beautiful. Without the Megow monocoque construction such strong, slender streamlined fuselages would be beyond the skill of the average builder. The skin construction of this fuselage permits easy installation of parts, and the skid mounting takes any motor . . . saving still more time and tedious work. With their high aspect ratio, steep climbing ability, extremely flat glides that take advantage of every thermal, these new models become ideal for contest purposes.

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Wingspan 51⅓". Stabilizer 18⅜". Wing area 276 sq. in. Uses any ⅝" bore motor. 2½" streamlined rubber wheels. Price **$3.95**
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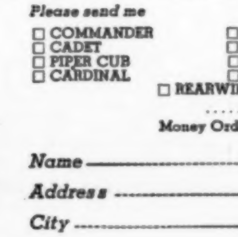

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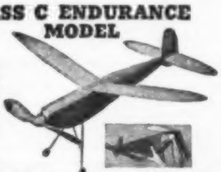

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Wing span: 110 ft.
Length: 73 ft.
Height: 22 ft.
Max. wing chord 14 ft.

The aspect ratio of the wing is 10 which was unbelievable a few years ago for high speed aircraft. Of full cantilever design, the wing contains integral fuel tanks and has a flush riveted skin. Wing floats are raised up under the wing when the boat is in flight.

The company states that the Model 31 surpasses their Navy PBY boats in range, speed and load. Thus it also has prospects of being a part of the Navy's air force. Incidentally 209 Consolidated PBY flying-boats have been delivered to the Navy since their origination.

Another new feature of the Consolidated is the use of a hydraulically retractable beaching gear. The nose wheel is housed in a well in the bottom of the hull and the side wheels swing upward into wells in the side of the hull. The side wheels are removable as well as retractable.

The Vought single-float seaplane which goes under the heading of the Vought-Sikorsky OS2U-1 is now in scheduled production. We first mentioned this plane in MODEL AIRPLANE NEWS over a year and a half ago when the basic design of the ship was being proposed. A fleet of them are now under construction for the navy. They are of the single-engined, mid-wing type equipped with the new N.A.C.A. slotted flaps.

In the racing field the latest Folkerts has been test flown and should be one of the leading contenders at the forthcoming National Air Races. It is of the same general Folkerts design.

It is now reported that Marion McKeen will install the old wire-braced wing on his "Miss Los Angeles" again and Lee Williams will be the pilot.

They say Mr. Israels, the old racing pilot designed the new Stinson spotster.

Transocean Flying Boat Dornier Do 26

The most important problem of the present day in the transatlantic airmail service is the development of an aeroplane which is capable of covering rapidly, safely, reliably and without intermediate landings, the approximately 5600 kilometer journey between Lisbon and New York, which is known for its bad weather. According to the existing state of the aeronautical art, the most favorable conditions for the accomplishment of this object are provided by the flying boat. The four-engine transoceanic flying boat Dornier Do 26, a 20 ton flying boat suitable for catapult launching, has been developed for the direct North Atlantic airmail service of the Deutsche Lufthansa and fulfills the existing requirements. The Dornier Do 26 is a flying boat with the qualities of an excellent landplane.

Since the Do 26, a cantilever semi-high-wing aeroplane of 30 m. span is normally launched by a catapult from the mother ships of the Lufthansa and lands on the water only in an emergency, this type has been purposely designed without the lateral stabilizing fins otherwise representing a well-known feature of the Dornier boats, and for the first time in the history of German flying boat design there has been applied to the boats the principle of the retractable undercarriage, the floats being retracted into the interior of the wing when the machine is in the air. The strictly aerodynamic design of the entire machine reacts favorably not only on the speed but also on the radius of action.

The all-metal body of the boat with two steps is subdivided by 8 watertight bulkheads. To satisfy transoceanic requirements, the boat is divided into a bow compartment for the marine equipment, a mail and freight compartment, a spacious pilot's cockpit, a wireless and navigation compartment, a tank compartment, a second mail compartment, a large resting room for the crew, a lavatory and a washroom. The boat itself offers very little resistance to the air and closely approaches aerodynamic perfection. The three-part wing comprises a rectangular V-shaped centre section projecting directly from the body of the boat and carrying the two slender engine nacelles. The ailerons and the landing flaps are disposed behind the edge of the wing.

The tail unit comprising an elevator and a keel fin with pivoted rudder is situated at the stern of the body. Elevator and rudder are compensated aerodynamically and in weight.

There are 4 Jumo-Diesel engines arranged in tandem in two engine nacelles. Whereas the two tractor screws are driven by the engines direct, the two propellers receive their drive by way of an extension shaft. To prevent damage to the propellers by spray, a new design has been adopted insofar as the rear engine and propeller are so constructed that upon starting they can be rocked upwards to the extent of 10 degrees. Trials have shown that the flying boat is still capable of flying without loss of altitude even in the event of failure of any two engines. The bottom portion of the boat itself forms a tank in the vicinity of the centre of gravity, a principle of construction also employed for the first

time. The fuel is located in four compartments separated by bulkheads.

Span: 30.00 m. Length: 24.50 m. Height: 6.85 m. Wing area: 120 square meters. Flying weight: 20000 kgs. Maximum speed: 335 km.p.hr. Travelling speed: 310 km.p.hr. Landing speed: 110 km.p.hr. Radius of action: over 9000 km.

Streamlines

(Continued from page 20)

urally, on an endurance model any such important factor cannot be overlooked. Another specific problem is caused by two airfoils in close proximity (Picture No. 14). The flow tends to leave the inner surfaces, causing a force about four times as great as with one surface alone. This comes into effect chiefly at wing and fuselage connections. For this reason, wings should be cut in as much as structural strength will permit, so that effect will be as small as possible, and then carefully filleted.

It is impossible to do anything in three dimensions on airplanes, but car profiles afford interesting pictures not so far removed from our work. The Model T shows pressure in front, twirls around the windshield, and tremendous vacuum in the rear. (Picture No. 15.) If speeds had ever been high, it would have paid to tow a trailer around all the time, as the decreased drag would have been a great saving (Picture No. 16). We are still far from perfect in our automobile shapes (Picture No. 17), but it is probable that the structural difficulties of designing and producing a true streamlined car will make us keep to present lines for a while at least.

Lift

Usually the forces on an object are not simply drag. On a flat plate, for example, the general rule is that the force acts perpendicular to the plate. If the plate is at a slight angle, this force is back and upward, and by the parallelogram rule may be resolved into two forces, lift and drag. They are tied up with other forces making a more complicated pattern, but at present we are only interested in showing how they are produced.

On a flat plate the lift is derived chiefly from the pressure of the air on the bottom surface (Picture No. 18). Or, another way of looking at it, the lift depends upon the amount of air displaced downward. The vacuum on the top helps considerably but is chiefly drag. Recently a new theory for lift has been developed. It depends upon a theory in physics that the sum of energy in a system is constant. That is, if the speed at one point (kinetic energy) increases, the pressure at that point must decrease. Examining any of the thick streamlines shows that the airflow speeds up along the sharply curved points. Since a streamline is symmetrical, pressure on top and bottom balances each other. But cutting a streamline in half leaves normal pressure along the flat and decreased pressure along the top. This means that the section will lift at 0 angle; something that a flat plate will not do. Since this shape would have a high drag, we round off the nose, leaving a Clark Y section (Picture No. 30). Changing the angle increases the drag and the differential between top and bottom speeds (hence, lift) until the section stalls (Pictures 31 and 32). That is, air twirls around pretty generally, ruining everything. The Clark Y is a good average section. It may be varied in many ways. In general, making it thicker increases the lift at the expense of greater drag. Hence thick sections are usually found on slow flying gliders and models. Also, increasing the under camber increases the effect first noticed with a flat plate, making a greater downward flow of air. An Eiffel 431 shows this effect moderately and is an excellent model section. (Pictures 27 and 28). It has one defect in that it stalls at a low angle (Picture No. 29). Increasing the under camber to the extreme we have a single surfaced airfoil. One of the best of these is the McBride B7 shown (Picture No. 19). This was high lift and a high stalling point (Picture No. 21), but is hard to work out structurally. It also shows excess lift at low angles due to the air twirling under the nose (Picture No. 20). We may get around these difficulties by changes as in the S11, an original airfoil (Picture No. 25). The dip in the nose reduces the drag at low angles and allows a strong leading edge (Picture No. 24). This is proven by flight tests to be one of the best of model airfoils (Picture No. 26).

There are a number of variations in indoor sections. Moving the hump farther forward produces a higher lift at the expense of greater drag (Picture No. 22). Also, turning up the trailing edge produces some interesting results (Picture No. 23). In the first place, it produces a more stable section. Notice that on other airfoils (B7, for example), as the angle increases, the region of rapidly flowing air on the top is moved forward. This means that the lift is moving forward, which tends to stall the model. Decreasing the angle tends to pro-

duce a dive, a very unstable situation. Turning up the rear holds the air down all along the surface—keeping the center of pressure practically constant. Another thing is that this prevents a stall. All in all, this seems to be a very promising section and worth further experimentation.

Going in the other direction, and dipping down the lower surface toward a streamlined shape, we come to a new type of airfoil—the so-called streamlined airfoil (Pictures 33 and 34). As they are nearly streamlined, the drag is low, but *the lift is also low.* These have a very high efficiency and a high stalling point, (Picture No. 35) but model builders are, as a rule, making a mistake in using them, because the increased speed necessary to lift the model so increases the overall drag (including body, etc.) that the total efficiency is very much less. The sections were intended for use on high speed transports and racers where speed is at premium. Their only use on present models is on tail surfaces where their high stalling point and steep fluctuations of lift make them very valuable. The new rules requiring a twenty second gas model motor run do put a premium on speed, and since the light models used will probably go up on the prop, there's a possibility of using them here.

This fairly well covers the field of airfoil except for the mechanically changeable ones. It is possible that as soon as structural difficulties have been overcome these will prove to be very valuable. The most valuable at present incorporates the wing slot (Picture 38; compare with Picture 32). At low speeds the slot is closed, making a normal airfoil. At high angles decreased air pressure moving forward opens the slot. Its shape forces air down along the wing, delaying the stalling point until later and hence allowing the ship to climb at a much steeper angle.

In review let us say that streamlining is of utmost importance. FIRST—Bodies should, if possible, be plotted to some known profile section and the cross-section should, if possible, be a tear drop to decrease drag in a climb. SECOND—Wing connections should be made as small as possible and carefully filleted. THIRD—The best airfoils for endurance models are of high under camber, the higher the better as far as structurally possible. FOURTH—An upturned trailing edge is valuable to increase stability and stalling angle. And FIFTH—Streamlined sections are excellent on tail surfaces and possibly on new twenty-second motor run gas models.

Make Your Own Airflow Analyzer

If you are interested in experimenting on your own, or in making an excellent aviation demonstration piece, try this easy device. Carefully build a 2" high frame of 2-1/4" x 1/2" white pine around a 30" x 18" plywood panel. Cut out two strips 1-1/2" high x 1" wide x 22" long. Round the ends and nail in place to separate the working chamber from the return channels. Bend 1-1/2" wide strips of tin into concentric circles as indicated. These are best soldered to a tin sheet to be mounted, but may be mounted in putty. Putty all joints so there are no leaks. Make an 8" wide paddle wheel about 5" in diameter and mount in one end so that it just misses the

bottom. If possible get a small variable speed motor or use variable pulleys. Best results are obtained with black ink colored water (about 1" deep) and only a little of a fine-grained aluminum powder.

It is best to keep test sections no longer than 5" or wider than 2". Make them about 1-1/2" high.

Use floodlights at all times at a low angle to the water. For photographs use 6 photofloods at about 4 ft. with an exposure of 1/25 at F4.5.

The Colibri Takes The Air

(Continued from page 11)

bands by cementing pieces of wire or bamboo at the point of contact.

Flying

Get your center of gravity at or a little behind the center of the wing chord. The less incidence you have to use for a flat glide the better off you will be. Glide the model several times and make sure that she is not diving. Make the model circle to the left under power and don't expect it to climb with half throttle, because these small motors are not as efficient as their big brothers. Well my time is up. Happy Landings!

The Physics of The Airplane

(Continued from page 28)

also tend to "diffuse" readily. This means that the molecules of one gas are quite easily scattered among the molecules of another kind of gas. This action is, of course, not quite so rapid as that of a gas entering a free area or an area of good vacuum (as in the case of the aircraft engine combustion chamber), since the attendant motion is frequently arrested by molecular collisions. This is exactly the process which occurs in the carburetor of an aircraft engine. The gasoline fuel, in the presence of jacketed engine heat, gives off vapors which come into intimate contact with the atmospheric air entering the carburetor mixing chamber. The molecules of the two gases are buffeted about so that the two elements diffuse readily through one another, the individual molecules being widely disseminated throughout the confines of the mixing chamber. Then upon entering the combustion chamber of the engine cylinder, being compressed and ignited, the resultant expansion causes the rapidly moving molecules of the gas to strike innumerable blows against the sides of the cylinder walls in accordance with the kinetic theory of the pressure of a gas. In the final analysis, all of these blows combined compose a continuous pressure which motivates the piston, the moving element in an engine.

Scientists have found it possible to calculate the velocity with which gases produce their impact against the walls of confining vessels. For standard air to produce a pressure of one atmosphere (roughly 14.7 pounds per square inch at San Francisco), a velocity of approximately 450 meters per second is required. For an equivalent pressure of hydrogen gas, which is only one-fourteenth as heavy as air, the requisite velocity acquires a high value, being 1850 meters per second. This condition accounts for the relatively high diffusion of hydrogen gas through porous walls. Lighter-than-aircraft employing hydrogen gas as a lifting medium suffered heavily due to the loss of hydrogen through the porous envelope of goldbeater's skin, thus necessitating fre-

quent replacement of the gas or a purification of the same by compression and then expansion in a gas reclamation plant. Coupled with the extreme degree of inflammability presented, this high rate of loss has been a potent factor in causing hydrogen gas to be completely eliminated from consideration as a lifting medium for balloons and airships in favor of the heavier, but more advantageous helium gas.

Although liquids diffuse rapidly into one another in a manner similar to that of gases, the process is not such a pronounced nature and acts considerably slower since the distance between the molecules is considerably less. An example of this that is frequently encountered in aeronautics involves the presence of water or condensed moisture in a gasoline fuel feed line or tank. The heavier water sinks to the bottom where it displaces an equal volume of gasoline fuel. In fact, this system of water displacement is used for emptying fuel tanks of gasoline which are imbedded in the ground at airports. Water is simply pumped into the tank, forcing the lighter weight gasoline to the surface and out the supply line to the airplane. This phenomena accounts for the design of the simple moisture trap incorporated into gasoline fuel tanks for lower powered engine installation employing a gravity feed. The spout, to which is attended the fuel feed line, extends upward an adequate amount above the floor of the tank to clear whatever moisture content might be deposited thereon as illustrated by drawing of Figure 1. The diffusing characteristic of liquids is more or less a function of the density of the respective liquids.

The diffusion of solids is far less pronounced than that of either liquids or gases, although the process can be effected under the proper conditions. A familiar example of this is embodied in the plating of structural metals with suitable materials which are impervious to corrosion. The diffusion of solids occurs to a more accentuated degree at elevated temperatures, as is evidenced by the process of welding aircraft structural members in the course of their construction or repair. Thus, it is amply proved that molecular motion exists in matter in the solid state as well as in the liquid or gaseous states.

We have seen that molecules in a liquid are entirely free to move with respect to one another. At the same time, they are held together by the attractive forces of the molecules on each other. This attraction for like molecules, as for instance, two molecules of water for each other, is termed "cohesion." In a similar manner, liquid molecules possess a tendency to cling to the molecules of a solid. This latter attraction of unlike molecules for each other is termed "adhesion." This tendency of the molecules to cling together becomes more pronounced in the case of the more viscous liquids as, for instance, oil and casein glue. The entire principle of lubrication of the high speed aircraft engine relies to a large extent upon the factor of adhesion. Hence the small particles, or globules, of viscous lubricating oil cling to the smooth cylinder walls and bearing surfaces, being due to the force of molecular attraction. Another familiar instance of molecular attraction exists in the case of glued joints in airplane structures. Occasionally, the tendency of adhesion becomes so great in the latter case that the joint formed in this manner exhibits greater strength than the material out of which it was formed. In general, the force of attraction of molecules for each other attains a large magnitude but acts through only a small distance.

The forces of molecular attraction in a liquid are responsible for the phenomena of surface tension, which causes the surface of any liquid to behave as if it were completely covered with a thin elastic film. This condition can be readily explained. The molecules existing in the mass of the liquid are subjected to attractive forces acting equally in all directions since they are entirely surrounded by similar molecules on all sides. However, the molecules on the surface have nothing to attract them on the side away from the liquid. As a consequence an unbalanced force is created, the molecules on the surface being pulled toward the interior of the liquid by the force of attraction of the molecules existing within the mass of the liquid. The film which is thus created can only be broken by the application of suitable force.

A common example in naval aviation provides an interesting example. Several patrol bombers were recently poised upon the calm waters of an inland harbor awaiting flight orders that were to take

them over the Pacific Ocean to the Pearl Harbor Airbase in Hawaii. The surface tension presented to the large hulls of these airplanes by the unruffled waters might have possibly proved an unsurmountable obstacle to the take-off had not smaller seaplanes roared on ahead of the wallowing big boats, thus creating a man-made choppiness which effectively shattered the troublesome water seal. It is equally dangerous for seaplanes to land on slick bodies of water, since the surface tension may be so great and momentarily reach such a high value when the hull or floats contact the water, that the seaplane would be nosed over and cracked up.

Seaplane floats as well as the larger flying boat hulls have a step built into their structure approximately one-third of their length from the stern. This arrangement, which assumes the form of a break in the bottom of the float or hull, is designed to assist in securing dynamic reaction from the water at the take-off. Common practice incorporates vent tubes into the flotation member. These vent tubes function in feeding air to the partial vacuum which exists behind the stepped portion of the float when it is in swift motion along the surface of the water. The admission of air into this area of partial vacuum makes possible the attainment of high taxying speeds, and most important from our present point of view, helps break the surface tension or seal existing between the bottom of the flotation member and the water. This type of construction is illustrated by the drawing of Figure 2.

The molecular forces which are responsible for the creation of surface tension also give rise to another condition called "capillarity," the practical application which is widely employed in the field of aeronautics. Should a glass tube of very small bore be dipped into a container of a liquid, say water, the water will immediately wet the inside of the tube and rise within it. The smaller the bore, or inside diameter, of the tube, the greater will be the height to which the liquid will rise. In the case of liquids which do not tend to wet the inside of the tube, as for instance, mercury, the column of liquid is depressed instead of rising within the tube. Capillarity is merely the result of the forces of cohesion and adhesion at work.

It is readily seen that if the cohesive forces between the molecules of the liquid are less effective than the adhesive forces between the liquid molecules and the

molecules on the wall of the tube, the liquid will wet the side of the capillary tube and will immediately rise therein. The reverse is true of the mercury where the cohesive forces are of greater effectiveness than that of the adhesive forces. A force of capillary attraction is also exerted by a porous body in drawing up a fluid, the principles underlying this action being exactly the same as outlined previously.

Aircraft inspectors while engaged in the routine checking of woods as an airplane construction material are extremely vigilant in the detection of spiral grain. An appreciable deviation from straight grain in airplane woods reduces their strength characteristics considerably and represents sufficient cause for rejection. A widely employed and authentic test for this functional discrepancy consists of placing a few drops of brilliantly-colored dye or ink, red, blue or green, on the tangential face of the suspected timber specimen and noting the direction which capillary action draws the ink along the fiber of the grain. Distant-reading pressure thermometers of the type installed on aircraft engines for the recording of coolant and oil temperatures are equipped with a suitable capillary. In this case, it consists of a length of plain drawn copper tubing, the internal diameter of which is extremely small, measuring from approximately 0.014 to 0.020 inches, and protected by a flexible metallic braided casing.

The capillary attaches to a standard bourdon gauge at one end and a suitable bulb containing a liquid whose change in volume or vapor pressure with temperature is transmitted through a capillary to operate the gauge. The volatile liquid in this case is methyl chloride. The liquid will always accumulate in the cooler parts of the assembly if it is free to move without restraint. Thus, when the bulb is located in the hottest area, the capillary and the gauge will fill with the liquid. The indication of the thermometer is then based upon the amount of the liquid still remaining within the bulb.

The capillary action of a gas is made use of in the capillary-leak type of rate-of-climb indicators. These instruments function in indicating the rate of ascent or descent of an airplane. The instrument, which is illustrated in Figure 3, operates as follows: One side of the sensitive diaphragm is exposed to the outside atmosphere, the entire assembly being connected to the pointer moving over the face of the instrument by means of a suitable mechanical linkage. The capillary leak tube functions in attaining an equalization of the pressure within the system. In view of the fact that the flow of a gas through a capillary tube depends upon the viscosity of the gas only and is independent of density, the calibration of the instrument will be the same at all altitudes. The pressure difference is indicated on the dial which is graduated at rate of climb. For instance, in descending, the pressure of the instrument will lag somewhat behind the pressure of the outside atmosphere because of the resistance offered by the capillary tube.

NOTE: The authors wish to extend thanks to the many readers who have shown interest in this series of articles and who have been so kind as to write letters and comments.

Build and Fly the Fairchild "82"

(Continued from page 23)

longerons are "vee" shaped and cemented together. A short piece of 1/16" square stock used as an upright completes the tail end. A small tail wheel made from either wood or metal is attached to a fork axle and mounted with an application of cement to a horizontal cross member situated between the lower longerons. See side view fuselage drawing. Bulkheads 3 to 8 inclusive are held rigidly in position by cementing 1/16" square balsa stringers of proper lengths in the notches provided within. Arrows identify the positions for the 1/16" square stringers.

Nose Cowling

The nose cowling unit is made up in three parts; the ring cowl former, former 1, 2 and 2A. Measurements for cowling formers may be taken directly from the plan for they are in full scale. Former number 1 is identical to size and shape of former number 2 with an exception that it is twice the latter's thickness, and is solid only for the diamond-shaped nose plug hole. Former number 2 is cut to shape from 1/16" thickness sheet balsa. Space both 1 and 2 apart properly and insert short sized 1/16" square balsa stringers in their notches. The ring cowl former is finally cemented flush to num-

ber 1. Lastly, the cowling unit is completely covered with 1/32" sheet balsa which is applied in four equal sized sections. Use small model making pins to assist holding the curved portions of sheet covering in position until the cement hardens sufficiently to warrant their removal.

Nose Plug

A soft balsa nose plug is carved to shape in the manner shown on plate 2. The rear portion of the plug may be made either as an integral part of the plug itself or separately and cemented into position. The latter method is simpler and just as efficient. A hole 1/16" diameter is drilled through the center of the plug and an eyelet bearing cemented in the front end. Be sure the plug fits snugly in position.

Cabin Detail

The cabin hatch, of which detailed views are given on plate 2, is cut to shape from a soft balsa block measuring 7/32" x 7/8" x 2-1/8". The underside is hollowed out to a 1/16" thickness. The outer side is finished off with a smooth sanding. Cabin hatch former number 6 (full size) (left half shown only) is cut to shape and cemented into position as indicated on the side and top view of the fuselage drawing. Following this cement is applied to the rearmost portion of the cabin hatch and is firmly pressed against former 6. Then, small props cut from 1/16" square stock of proper size are cemented in upright positions to provide support for the cabin itself. These upright supports are identified by arrows on the side view drawing of the fuselage.

The landing gear wire is attached at this point to the fuselage. The wire itself is bent to shape from .038 and rests upon the lower longerons at the same time being cemented securely. Upon the completion of this operation and with the cement well hardened, the fuselage is ready to take its "skin" covering. The covering consists of applying 1/32" sheet balsa with the greatest care.

Fuselage Covering

The sheet balsa skin is applied in three sections on each of the fuselage sides. The side sections are identified by two sets of a series of dotted lines running the length of the fuselage. Space for the windows are cut as shown only in the upper section. In attaching each section, dab the sides of the bulkheads generously with cement and then press one section at a time firmly into position. Small model-making pins may be used to assist in holding the sections until the cement hardens.

Nearest the cowling where the fuselage takes on a more circular section it will be necessary to apply strips of gradual widths. This must be executed in a careful manner with each strip lying as close to the other as possible. Wood filler is used to fill in open spaces. The roof of the body is covered with a single piece

of sheet. The under-portion of the body is also covered with a single piece. At the rearmost portion of this piece an opening measuring 1/2" at the front end and 1" long is provided to facilitate application or removal of the power strands. The entire fuselage upon completion is given two coats of dope and afterward a fine sanding.

Landing Gear

The main landing gear struts are identified on plate 3 by L-4 of which two sets are cut to shape and joined as shown. The front of the foremost strut is grooved slightly to accommodate the landing gear wire. The wire is clearly shown in this position by the black line running down the length of the front landing gear strut in the front view drawing. The next addition to the landing gear assembly are the shock absorbing struts L-5. The upper portion of this strut is made from a piece of bamboo imbedded partway and cemented as shown. The lower ends of L-5 are cemented to landing gear struts L-4. L-5 is braced at the top by struts L-1, 2 and 3. Cement all brace strut joinings generously. A pair of hard wood wheels 1-1/4" diameter slipped onto each side of the axles and a drop of cement complete the landing gear detail.

Propeller

Pine or bass may be used for the propeller. The prop block should be a select piece free from knots cut to the following measurements: 3/4" x 1-1/2" x 7-1/2". Cut carefully to shape, balance perfectly and complete by securely mounting the prop shaft in the center of the hub with cement. A couple of brass washers are placed onto the shaft before forming the curved hook.

Tail Surfaces

The ribs sections for both the rudder and elevator surfaces are presented on plate 1. All ribs for the elevator are cut to shape from 1/16" sheet each bearing a 1/16" square hole. The outline frame of the rudder is shaped from 3/16" sheet tapering both at the leading and trailing edges to form a full streamline section.

The rudder fillet piece is shaped from a soft block of balsa measuring 9/32" x 3/8" x 3-3/4". When completed cement flush to the proper position on top of the rear of the fuselage.

The elevator is made in halves; each half mounting five ribs cut to the streamlined shape as shown. The fifth rib is placed nearest the fuselage side at the angular position indicated. A single spar 1/16" square bass is used to hold the ribs at proper intervals while 3/16" square balsa is used for the leading edge and 1/16" x 1/8" for the trailing edge. The tips are composed of pieces fitted to form a tapering edge. Cover both rudder and elevator parts with fine Jap tissue, water sprayed once, and complete with a single coat of dope. Mount the rudder in position over the fillet as shown. The elevator parts are cemented to each fuselage side and braced from underneath by brace struts 1/16" x 1/8" cut to necessary length. Be sure that the elevator lies perfectly horizontal. Struts E-1 and E-2 shown in full size on plate 3 are the elevator brace struts.

Wing Structure

The long narrow wing employs a typical Grant X airfoil section which we believe, for the first time, has been used in a flying scale model. In flight the model shows excellent climbing qualities with glides of unusual endurance. All twenty-one ribs are cut as required from 1/16" sheet soft balsa and cemented at proper intervals onto a single spar measuring 3/16" x 7/16" x 26-3/4" long. A hard balsa leading edge selected from the dimensions specified on plate 2 is sanded to shape to complete the front edge of the airfoil section and finally cemented firmly in position. The trailing edge is also selected hard balsa, tapered as shown, and cemented in position. Two stub ribs D are cut to the required shape and thickness, tapered and cemented flush to the sides of the first ribs on each side of the C/L mark. The slight recess existing between the stub ribs and rib E is filled in with a piece of sheet balsa measuring 1/16" x 17/32" x 2" long. Apply cement at all joints. The wing tip pieces are cut to shape from 1/16" sheet and fitted securely. A point to be observed carefully before cementing ribs into position is the amount of taper in the main spar nearest the last two ribs A and B.

The break for the dihedral attaining an angle of 1-3/4" is made at the points marked X shown at the center section in the top view plan of the wing, plate 2. Apply cement generously over these cracks and allow plenty of time to harden.

Smoothen up the rough spot with sandpaper and complete the wing structure by covering with fine Jap tissue. A single water spray over both sides of the entire wing and upon drying, a single coat of dope, assures you of a well balanced strong wing possessing good lifting characteristics.

Wing Struts

Struts W-1 and W-2 are the wing braces and are cut to shape and streamlined from hard balsa. In attaching struts between fuselage and wing, note that the rear strut is mounted straight in relation to the both points, while the front strut slants forward. The side view of the fuselage explains this detail clearly. Interbrace strut W-3, shown in position on front view plan, is made up from three pieces of hard balsa and cemented to form a single unit. A set of two will be needed.

Assembly

In mounting the wing onto the fuselage for final assembly, apply a generous amount of cement to innersides of the stub ribs D, along the fillet piece between them and along the underside of the trailing edge. Place the wing firmly into position. The fairing piece shown on plate 2 is then cemented directly over the rear portion of the wing as indicated in its position on the side view drawing of the fuselage. This part provides a smooth flow between the wing and the fuselage. Due to the slight undercamber of the airfoil section, a small opening will be noticed just between the lower part of the wing and the part of the fuselage it rests upon. This space may be filled in by cementing a small piece of sheet balsa fitted to conform to the required shape. The wing struts including unit W-3 are cemented into position securely thus completing the model.

Flying

Motive power is derived by using six strands of 1/8" flat fresh rubber. By using a winder the full benefit of power is at your disposal. The ship, designed as it is on the plans, will fly well. However, your ship may be bound to stall or perhaps act a bit erratic—those things happen. In the case of a slight stall wherein the tail seems a bit heavy, compensate by cementing (if handy) small BB shots along the inner ridge of the nose cowling. A few heavy rubber bands placed around the rear of the cowling will aid too. The model is built ruggedly and can stand mild abuse; but being a really good flier, give it a wide berth. . . . She'll use most of it.

The Instructor

(Continued from page 26)

enjoyment. Remember that you put considerable time and effort and a bit of cash into the construction of the craft—it's no crate—it's a potential top-place ship if you'll give the plane half a chance. Who ever heard of the army or navy accepting a new design airplane without first conducting exhaustive tests, numerous check-ups and a period devoted to studying the plane's

peculiarities?

And if you're a bit on the novice side . . . ask the experts for advice . . . don't let those "grandstand kibitzers" (recognized by all talk and no knowledge) try to adjust your craft. Keep an eye on the leading flyers and learn from them . . . they're a grand bunch of fellows—always ready to lend aid if properly and courteously approached. But don't pick an inopportune moment to intrude with a request for help . . . wait till your "expert" has a free minute or two . . . don't forget, he's out there to compete, too.

The Instructor hopes he has been instrumental in making you pause to reflect —to promise that you'll be a bit wiser when preparing for that next meet—that you'll have all the necessary paraphernalia for correct contest participation—tools, replacement parts and a couple of bottles of "soda pop" to sooth that inner man when the competition becomes tough, or the plane just doesn't seem to perform properly.

Relax. Try taking it a bit easier—it's a heap more fun. Right?

A Soarer Without A Tail

(Continued from page 17)

then roughly shaped to the proper cross-sections with a knife. Note that the top has a "Vee" shaped recess to accommodate the dihedral of the center section. Pin the wing in position on the body and check the balance. The model should balance about 2 3/4" from the leading edge of the center section. If nose-heavy carve the nose a trifle narrower till the balance is perfect. In the unlikely event that tail heaviness is present, ballast may be forced into the nose to correct this condition. The fuselage may now be sanded, covered with sections of tissue, doped several times and cemented solidly to the wing.

Hooks G and H are formed of .034 piano wire and cemented securely in the positions given on the plans.

The "golf club" is simply made of a 1/4" square boom 16" long, and a rudder of 1/16" sheet. Hooks I and J are glued to the boom. The upper loop of J is NOT cemented to the wing, but merely rests against the underside to prevent the set of the auxiliary rudder from rolling it to a horizontal position. The loop should press against the left side, if the auxiliary rudder is set to the right. This is the proper line-up for counteracting the turn of a glider that circles to the left in free flight as did the original. If the model is to circle in the opposite direction all other settings are also necessarily reversed. These directions may sound a bit complicated but if followed carefully no trouble can result.

Flying

The model if properly balanced will probably glide perfectly the first time. Minor adjustments in the gliding angle may be made by bending the aluminum trimmer tabs. The tailless is best circled by warping the rudders in the desired direction, supplemented by bending the elevator on the inside of the turn-up slightly. A circle about thirty feet in diameter is most efficient.

For tow-line flying, tie about fifty feet of No. 8 cotton thread to the boom, approximately one inch behind hook I. Have your

assistant hold the glider level and at a slight upward angle. Start to run slowly, increasing your speed till the model will rise no more. If the full length of the thread has not been converted into altitude, it should be attached slightly farther back on the boom. Should the model keel over while being towed, correct this tendency by giving the "golf club" opposite rudder. Unlike other soarers the tow-line may be given a strong tug to release the glider. The quick recovery and "settling down" of the tailless makes it impossible to lose altitude in spite of any maneuver this procedure may cause.

For conversion into an experimental, powered model a trough to retain a motor stick is built on the center of the wing. It consists of two sides; E, of 1/16" sheet in which the grain runs vertically and a filler block, D, of 1/4" sheet fitted on the center rib to prevent the motor stick, F, of 1/4" x 5/16" hard balsa from rocking. The prop is carved from a block 3/4" x 1 3/8" x 7 1/2" laid out as shown on the plans. It is preferable to carve a left-hand type prop, to permit hand winding in the accustomed clockwise direction. The motor stick with eight stands of 1/8" flat rubber should be of such length that with the prop about one inch from the trailing edge, the model balances at the same point as for a soarer.

While we are personally convinced of the superiority of the tailless as a tow-line soarer, further experiments such as using a tractor propeller, increasing the model's weight and especially with gas models of this design will prove most interesting and fruitful projects.

Model America at the Nationals

(Continued from page 29)

the model builders on the field. Apparently it was another case of super-organization interfering with its own functioning because of its ponderous nature.

This consideration made it necessary to hand-launch the gas powered models, as the fairly long grass and dead air made it nearly impossible for the little ships to take off from the ground. This is not in accordance with the N.A.A. rules, unfortunately, and therefore flights made under these conditions were ineligible for recognition under the N.A.A. records. This diversion from the customary manner of launching should not be attributed to the lack of efficiency or energy of the meet officials, for they did everything in their power to overcome the innumerable unexpected obstacles which prevailed throughout the contest.

A heavy shower early on Saturday morning cleared the air for the Gas Model Event which fell on that day. However, it induced a fairly lively breeze which cut the flight times to a certain extent and was the cause of a number of spectacular crashes. Except for the hazard to life and limb of the airplane pilots, the National Air Races have nothing on the National Model Championships. Even the most phlegmatic model builders could not help but thrill at many of the maneuvers executed by the gas powered ships during the afternoon.

A number of planes left their wings fluttering in mid-air while they roared earthward from several hundred feet altitude, to disintegrate into a spray of uncollectable

parts, upon impact with the ground. Flights were run off with great rapidity and the weighing tables kept eight take-off runways supplied with continuous activity. This performance, from a contest director's standpoint, was highly remarkable, for in the 7-1/2 hours of the contest, 1100 flights were made! This kept the headquarters tent staff working along at a great rate, assorting cards and recording the names and times of the contestants. As usual, a crowd of over-interested and enthusiastic spectators interfered, to some extent, with the operation of the meet. On a number of occasions flights had to be stopped and the field cleared before the ships were again allowed to take off. This was entirely in the interest of the spectators, inasmuch as the type of plane which prevailed at the contest was the high-powered, low-weight jobs which tore skyward with the velocity of a skyrocket. Many construction kits of this type of plane were produced by one manufacturer who gained great prestige at the fine performance which it evidenced. Many of the events were won by this type of ship. This manufacturer is indeed fortunate in the fact that the new rules, passed by the Academy of Model Aeronautics, encour.

(Continued on page 58)

POWER MODEL CONTEST
Class "C" Jr.-Sr.

Roy Roush	17	Ferndale	465.0	Gar Wood Tro. & Miniature G. P. Burgess Trophy
E. Barron, Jr.	19	Grayslake	241.06	
F. J. Lorenz	19	St. Louis	221.3	River Rouge Ex. Ace Motor
M. Spector	17	Cincinnati, Ohio	208.93	Baby Cyclone Engine
F. Bergert	18	St. Louis, Mo.	173.4	Berkley Trophy
R. E. Hoffmeyer, Jr.	20	Akron, Ohio	147.46	48 Everready Batts. & Xch. Awd.
F. D. Page, Jr.	17	Williamsport	137.93	Aero Coil & Xch. Cl. Award
Ceylon Frqser	19	Little Rock, Ark.	137.73	Xch. Cl. Awd. & Xacto Knife
Oliver Pfeil	19	San Antonio, Tex.	135.	Xch. Cl. Awd. & Xacto Knife
Frank Vollrath	19	Indianapolis, Ind.	134.6	Xch. Cl. Awd. & Xacto Knife

POWER MODEL CONTEST
Class "C" Open

Dick Everett	21	Elm Grove	295.3	E. G. Budd Mfg. Co. Trophy
Wm. J. Allsopp	21	Detroit	231.	Bay Ridge Trophy
Frank Draper	35	Charleston	200.66	Syncro Ace Special
Geo. Meyer	23	Overland	191.26	Mod. Parts Wh. & Xch. Cl.
Alfred Towle	24	Syracuse	181.06	Mercury Rep. Kit & Xch. Cl.
W. R. Cruthirds	46	Little Rock	171.33	Aero Coil & Xch. Cl.
Henry Gebbard	46	Milwaukee	143.82	Xch. Cl. & Xacto Knife Set
Walter Good	23	Kalamazoo	131.86	Xch. Cl. & Xacto Knife Set
Dobt. Gable	23	Reading	125.66	Xch. Cl. & Xacto Knife Set
Edwin Schunke	25	Milwaukee	122.8	Xch. Cl. & Xacto Knife Set

GAS POWER
Class "B" Jr.-Sr.

Max Wassem	16	New Philadelphia	535.33	$25 Ohlsson-Rice Award
Herbert Friedlander	17	Brooklyn	377.4	$10 Pesco Award

Robert Hoffmeyer	20	Akron	103.4	$7.50 Scientific Trophy
Leon Shulman	18	Brooklyn	102.67	Aero Coil & Xch. Plaque
Jim Gaff	18	Jackson	95.93	Aero Coil & Xch. Plaque
Gordon Murray	19	Brooklyn	92.13	Xch. Pl-48 Everready Bat.
Paul Girtenter	15	Milwaukee	76.73	H. A. Marshall Stop Watch
Harry Lipstine	19	Cincinnati	61.07	Xch. Club Plaque
Ed. Naudzius	20	Detroit	60.67	Xch. Club Plaque
George Gerpheide	16	Kalamazoo	59	Comet Award
		Open.		
Robert Besse	21	Cleveland	219.13	Auronca Trophy
Henry Thomas, Jr.	23	Akron	113.	Berkley Trophy & Cyclone
Dick Korda	24	Cleveland	101.07	Aero Coil & Xch. Plaque
Andrew Petersen	24	Los Angeles	99.4	Eveready Flashlight
George W. Meyer	23	Overland	90.53	Aero Coil & Xch. Plaque
W. H. Gowan, Jr.	21	New Philadelphia	86.8	Xch. Club Plaque
Ray Minott	22	Ames	79.07	Xch. Club Plaque
Richard W. Billett	26	Minneapolis	74.2	Xch. Club Plaque
Ed. Manning	40	Detroit	70.63	Xch. Club Plaque
Harold E. Coovert	25	Cleveland	69.93	Comet Award
		Unlimited Category—Jr.-Sr.		
Bob Wright	15	Topeka	234.	$100 Geo. S. Wheat Award
Vernon E. Krehbiel	20	Williamsville	222.33	$75 Geo. S. Wheat Award
Henry Velkoff	18	Fort Wayne	221.06	$50 Geo. S. Wheat Award
Harry Lorenzen	16	Detroit	218.2	$25 Geo. S. Wheat Cash Awd.
A. G. Wheler, Jr.	18	Syracuse	159.93	Foster Engine
Bill Redeker	15	Cincinnati	150.73	Berkley Trophy
Dean Allen	16	Detroit	117.6	Aero Oil & Xch. Pl.
Robert Jacobsen	19	Philadelphia	110.47	Xch. Club Plaque
Jack Dietz	19	Cincinnati	102.4	Xch. Club Plaque
Bob Grams	17	Wyandotte	84.	Comet Award
		Unlimited Category—Open, Radio Control Hdqtrs. Eqpt.		
Bud McClellan	21	Detroit	767.7	M.A.N. Mag. Trophy
Edwin Schunke	25	Milwaukee, Wis.	329.33	Ritz Propeller
Norman A. Cross	23	Detroit	227.73	Champion Spark Plug
Chas. C. Hinkle	22	Janesville, Wis.	221.13	Race Car Kit
John L. Ogilvie	22	New York City	187.93	Baby Cyclone Engine
Louis B. Mander	35	Swissvale, Pa.	181.33	Eveready Flashlight
Dick Korda	24	Cleveland, Ohio	175.4	Mercury Tool Kit
Chester D. Lanza	25	Cleveland, Ohio	134.73	Radio Control Hdqtrs.
Walter Good	23	Kalamazoo, Mich.	130.07	Exch. Club Plaque
Geo. W. Meyer	23	Overland, Mo.	129.13	Comet Award

Model America at the Nationals

(Continued from page 56)

aged this type of model.

Fortunately the weather was excellent during the four days of the meet. The flying activities were climaxed on Saturday night by a banquet at the Fort Shelby Hotel. After the ravages of the "inner man" had been satisfied by some very fine food, prepared by the hotel chef, the winners of the various events were presented with their awards. These consisted of an enormous number of trophies, cups and plaques as well as cash, merchandise and subscriptions to various aeronautical magazines. The awarding of the trophies required two hours, which will give you some idea as to the number of winners who carried home the "hardware," so to speak. This was done amidst the continuous stream of flashlight bulbs as newsphotographers snapped pictures of the winners. At the speakers table were members of the Detroit Exchange Clubs, who sponsored the contest. The President, Mr. Al Bruder, gave a short address in which he told how he was amazed at the achievements of the young men in this particular field. A number of other guests, prominent in the civic affairs of Detroit, were present.

The highlight of the banquet was the great food for thought which is "dished up" at every Nationals in the form of the "Daily Blurb." The entire group of contestants who attended the banquet were extremely restless until the "Blurb" made its appearance, for they all looked forward with great anticipation to this very unique feature of the meet. The editors, of whom our old friend, Al Lewis, is chief, did a marvelous job—it was bigger and better than ever and its pages were adorned with many pertinent and humorous sketches pertaining to the lives of model builders.

Perhaps many of our readers would like to see a copy of this outstanding publication. If so, write to us and let us know. We cannot promise that one can be produced, as only a limited number were made. However we will see what its editors can "pull out of the hat" in this respect.

Not the least of the events was the numerous meets and "conventions" held during the four days contest period. Before the start of flying activities Mr. Art Vhay, contest director, gave the contestants a "pep talk" and presented the philosophy which was to dominate the contest. On Friday night the many manufacturers and dealers who were present got together for a social evening and many interesting opinions concerning the model airplane industry were brought out. One was it has grown to such an extent that the leaders realize the necessity in getting together in some sort of organization. This organization would help to determine the manufacture and sales policy of manufacturers and dealers. Unquestionably it would help to smooth out many of the difficulties which now present themselves.

On Sunday the Academy of Model Aeronautics held its meeting. The question of all rules was gone over with a "fine-tooth comb," the gas model rules receiving special attention. The feeling seemed to predominate among the members that the rules should be as broad as possible; that they should not limit the experimentational activity of model builders to any extent beyond the point of insuring reasonable safety in gas model flying. The final rule changes passed by the Academy will be published at a later date.

Final activities were concluded Sunday, except for cleaning the odds and ends and packing them up for their return home. The only thing left to be done then was to get the news of the contest in proper shape for presentation to model fans who were not fortunate enough to attend this great annual event.

Though the 1939 National Championships has just been concluded, contestants are looking forward to the next Nationals. It has been rumored that possibly they will be held in Chicago.

Model builders who are now looking for other fields to conquer and flying contests to attend should not forget the Wakefields on August 6th and the Eastern States Meet on August 12th. The Wakefields are to be run off in New York; the Eastern States at Hadley Field, N.J. These should be very interesting exhibitions even to those builders who cannot participate.

A list of winners in the various events of the 1939 Nationals, with their flight times and prizes is shown on page 29.

Ocean Spanning Razor Blade

(Continued from page 26)

with consequential increase in load-carrying ability, a higher top speed and higher cruising speed, a slower landing speed and a more stable tendency in even the most strenuous maneuvers.

It took only ten months for Consolidated's forty-two hundred men to build the ship. But it took twice that long for its engineers to design it. We first heard of it as a 100-passenger airliner for Pan American Airways' famous design competition. But now it is not so big. It carries a maximum of 57 persons in twin decks inside the narrow, soup-ladle hull. And it carries them farther and faster than the original model could have. But perhaps this is merely a working model of that giant craft of the future!

The Model 31 is an all-metal design with the exception of cabin interior and fabric-covered control surfaces. It is a twin-engined high-wing cantilever monoplane flying boat and is powered by the most powerful air-cooled radial aircraft engines in the entire world: Wright's own aviation achievement: the Duplex Cyclone, 18 double-row cylinders of TWO THOUSAND horsepower!

The hull is built up on a structure of aluminum frames and stringers with seven water-tight bulkheads. This assembly is covered with aluminum coated aluminum alloy sheet. The hull is of a single step design and approaches a near-perfection in its mathematical exactness of curvature. The undersurface is flush riveted for

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smoothness. Within the nose section is the anchor, mooring and stowage compartment. Along the upper deck is the main command cabin with the pilot and co-pilot seated high atop the hull. Immediately behind them are the ship engineer and the communications men (a radio operator and a navigator); five men whose fingers control the pulse of the giant airliner.

When the first production model is completed there will be seats for 52 passengers for day operations and luxurious sleeping accommodations for 28 persons for transoceanic flights. At present the hull is a jumbled mass of engineering testing mechanisms. The upper and lower decks are strapped with weighted bags which are added and removed, changed and shifted for testing. Fuel analyzers, weight and balance machines, vibration, stress and strain testing apparatus, magnetic measuring instruments, noise locators and analyzers, all are doing their job every hour that Chief Test Pilot Bill Wheatley has the giant ship in the air. When those tests are completed, that maze of data recorders will make way for one of two things: luxurious passenger accommodations or heavy-duty machine-guns, bomb and torpedo implacements; no one at this date knows which. For the Model 31 Flying Boat has tremendous possibilities as a long-range fast-flying naval torpedo boat and patrol bomber and officials of the naval patrol-bomber base across the bay at North Island Naval Air Station have poked their noses inside this craft and sniffed pleasingly.

This new model bears little family resemblance to other Consolidated models, differing chiefly in its rearrangement of retracting wing-tip floats. The thin, razor-sharp wing was too narrow at the tips to accommodate Consolidated's famous floats and the Model 31 now swings them inboard and up into the wing where only their lower surfaces protrude. The wing is all-metal cantilever and flush riveted throughout. It is built up in three sections—two outer panels and the center section which mounts the engines and houses the big integral fuel tanks. The giant engines are mounted high and close inboard in the wing and are incased in small egg-shaped nacelles. But those dumpy nacelles, elliptical in section, have something a more symmetrical, flowing streamlining does not have; for the Model 31 was several hundred hours in the wind tunnel at Caltech's Guggenheim Foundation before construction was ever started. The nose cowlings are equipped with engine cooling flaps and each engine is equipped with a retractable working platform. Within the nose of each engine is the powerful gear which controls the huge Hamilton Standard hydromatic full-feathering propellers of sixteen feet diameter.

The twin elliptical rudders are slung high on the end of the cantilever stabilizer at the top rear point of the soup-ladle handle tail boom. These are statically and aerodynamically balanced through the use of heavily weighted construction forward of the hinge line. The fixed surfaces are flush riveted, the movable surfaces fabric-covered and equipped with trimming tabs. The pilots' controls to these surfaces are boosted up with an electrical drive which lessens the fatigue of long-range flying.

A novel feature of the Model 31 is the introduction of aviation's first retractable beaching gear of tricycle design. The two rear wheels are mounted aft of the center of gravity and swing upward and inward into openings to the rear which are sealed by retracting metal plates. The nose wheel slides up and down in a keel opening which is also covered by retractable panels. Although not intended for an amphibian, an emergency landing could be made on this gear in the event of power failure over dry land.

Entrance to the cabin is made by a small hatch on the lower deck on the port side of the ship. Stairs lead to the upper deck and the eight main cabins and there are no impediments to mar the uniformity of them.

The last word in modernity, the Model 31 equipment sounds like a list of America's advertising equipment concerns. Among these is the hydraulically operated retractable beaching gear controls, Lord instrument panels, Exide battery equipment, GE lighting equipment, fire-extinguisher appliances, Eclipse starters, Bendix radio equipment, and complete Sperry directional gyro, gyro-horizon, gyro-pilot and General Electric tachometers and motor recorders.

The Consolidated Model 31 Flying Boat has a length of 73 feet overall and is 22 feet high. Its amazing wing has a span of 110 feet and is only 14 feet at the root chord, its maximum width. Gross weight is near the fifty thousand pounds mark, which gives the craft a power loading of only twelve and one-half pounds per horsepower, less than its smaller brother, the PBY Bomber.

Performance figures are not as yet official but according to Bill Wheatley the big ship hit a top speed of better than 275 miles per hour at less than full throttle on its first test flight and cruised at 240 miles per hour. It lands at little more than 70 miles per hour and all present tests indicate a cruising range of better than ten thousand miles (about THREE TIMES that of Boeing's big Yankee Clipper!)

What are the plans for this new and startling ship? Well, the navy is definitely interested in the craft and wants large numbers of them. American Export Lines (Trans-Atlantic airline which has just begun survey flights with their new PBY cargo model) will need half-a-dozen of them when profitable operations are foreseen. Thus we do not hesitate to predict the brightest future of any airplane announced this year for the Consolidated Model 31 Flying Boat. As an airliner it can carry more people faster and farther than any ship yet constructed and as a mighty patrol-bomber it could present such a powerful weapon of aerial terror as has never before been seen in the air.

Fundamentals of Model Plane Design

(Continued from page 13)

Now that we know all the factors that are required for the successful operation of an airplane, it is necessary to determine what mechanical means should be used in order to have a plane function in accord with the requirements of these factors.

An airplane is a complete assembly of all these required mechanical means placed in correct relation to one another. When they are assembled in their correct relative positions, according to the dictates of past experience, the resultant combination will appear as in Fig 1, a full-fledged airplane. The figure shows a typical model plane. The parts that compose the structure and the functions they perform are as follows:

The wings serve as a means of lift; the propeller acts as a means of propulsion; a small "gas" engine is the source of power; the tail surfaces as well as the correct form and relative position of other surfaces and weights serve to provide stability; the wheels and their supporting struts act as a landing gear; and the fuselage serves as the structure which holds together in their correct relative positions all the units which function as a requirement of flight. Control of such a plane is attained by setting the tail, wings and propeller at definite angles to one another and in certain positions relative to the center of weight of the airplane.

A device may have all the required structural factors, such as wings, tail surfaces, propeller, engine, etc., yet it may be incapable of flight. This is the enigma which baffles many would-be model builders. Usually the beginner starts his model plane adventure by copying the proportions of a full scale airplane. Nothing could contribute more to failure than such a procedure. The model builder observes the characteristics of the plane that may be seen with the eye, but disregards the intangible unseen factors; such as centers of weight, angles of the surfaces and distribution of structural weights. These are extremely important and must have very definite values in every particular airplane. The size of a plane has an influence on the value of these intangible factors even though the smaller model may be a duplicate of the full scale ship in all visible aspects. Thus a small model of a full scale craft may not fly as expected and perhaps not at all.

In other words the flight capacity of a plane depends upon the relative size, shape and position of the parts of which it is composed.

Obviously therefore if the model designer understands how to *proportion* his plane correctly he will be able to design models that will fly properly.

The correct basic proportions of a flying model plane may be established by the application of a few simple rules. Figure 2 shows a diagram of a typical model plane on which is indicated the correct proportions of its various parts. If a model builder constructs his plane according to these proportions his plane will operate satisfactorily. The rules of proportion given are purely basic. In order to design various types of planes it is necessary to be able to apply more specific rules which govern the detailed characteristics of the parts that function to fulfill the requirements of flight.

In the following pages therefore, rules of design governing the wings, the propeller, the power unit, stability, the landing gear and the control of the plane will be given and discussed in detail.

The Wings—How Lift Is Generated

Everyone takes it for granted that a wing will lift when used in the customary manner. However, possibly few of us have stopped to think why a mechanical means of this nature should give such results. It isn't the purpose to go into great detail at this point; however a general idea of the action of the air on any moving wing surface should be understood in order to know how it will apply to special rules of design.

The lift of any moving surface may be demonstrated in a very simple manner:

Just hold a piece of cardboard in your hand in an extended fashion and move it through the air with the forward edge raised slightly. The air will create pressure on this cardboard strip in an upward direction and slightly backward. The person holding the cardboard can feel the lift very readily if it is moving through the air at a reasonable speed.

The lift is produced by infinitesimally small air particles passing over and under the surfaces of the cardboard. Inasmuch as these particles have mass or weight, they tend to keep moving in a straight line. As soon as they strike the cardboard they are deflected. However, they resist this imposed change of motion and press tightly against the under surface of the cardboard.

Not being able to pass through this surface they are deflected downward. The reaction of this is a pressure on the cardboard upward and backward. This, in effect, is lift and drag. Unfortunately there is always a little resistance caused by a wing when lift is generated by it. This is the price that must be paid when the desired effect is obtained.

However, this is not all of the story. The lift of which we have been speaking is generated by the effect of the air striking the under surface of the wing. On the other hand about three times as much lift as this is generated by the vacuum which is created by the moving air over the wing. Normal air pressure at sea level is 14.7 pounds per square inch. Now, if the pressure on the top surface of the wing can be reduced, a suction, so-called, will be created. The difference between this reduction of pressure on the upper surface and the increase in pressure on the lower surface of the wing amounts to the total lift generated by it.

Diagram 3 gives a graphical picture of the airflow over a flat surface, AB. It can be seen that the air which strikes the under side of the wing, at P, is deflected. The air passing over the wing tends to keep moving in a straight line. Inasmuch as the rear of the wing is deflected, such an action causes the air to pull away slightly from the upper surface of AB, thus causing a partial vacuum. Actually the air is not pulled entirely away but curls downward, as shown by the lines over it, AB. If AB is inclined at a very small angle the lines of airflow over the wing will be fairly smooth. However if the wing is inclined at a higher angle, as shown in the figure, whirls of air will occur close to the upper surface. At this point the lift begins to drop and the resistance to forward motion increases considerably. It is a critical angle of flight and is often called the "stalling angle."

The air pressure and suction upon the wing in flight produces a force on the wing acting perpendicular to it. Inasmuch as the wing is at a positive angle in flight this force will be inclined slightly backward.

In figure 4 the resultant force on the wing, XY, is shown at A. This may be divided into two forces; a vertical force, L, and horizontal force, D. These components of force A in effect are: Lift, (L) and Drag, (D).

If the length of line A in the diagram represents the actual amount of force generated by the wing, XY, then the length of the line, L, will represent the amount of

lift generated by the wing and the length of line, D, will represent the amount of drag.

Curved Wing Surfaces (Cambered)

So far we have been discussing flat surfaces or wings. Early experiments disclosed the fact that greater lift and less drag could be obtained by curving the surfaces slightly, as shown in Fig 5. XY represents a curved wing, such as might be created by a curved sheet of cardboard or balsa wood. Curving the wing in this manner has the effect of inducing a smoother airflow over its surface. Under any conditions if the air can be made to flow smoothly over a wing, more lift and less drag will result. Thus we can see that a wing, such as shown in XY, will be more efficient than a flat surface.

As in the case of a flat wing, there is pressure on the under side of the curved surface and a vacuum generated over the upper surface of the wing. The vacuum is indicated by the shaded portion at V. The lines with the arrowheads indicate how the air flows over this curved surface. You will note that the curved-down nose or leading edge of the wing induces an upward slant to the airflow over it. This upward flow tends to bounce the air particles away from the upper surface of the wing.

On the other hand the wing curves gradually away from the airflow. Thus you might say that the air tends to pull away from the upper surface of the wing and the wing tends to curve away from the airflow. This induces a partial vacuum or suction. Inasmuch as there is no abrupt change in the airflow produced by the wing, it flows smoothly over this surface.

Position of Maximum Camber

Though a curved wing surface is more efficient than a flat wing, the character of the curve used on the wing has a great deal to do with its lift and efficiency. The arc of a circle; that is, a perfectly regular curve, can be used. This gives fairly good results. However from experiment it has been determined that the best results are obtained when the maximum heighth of the curve, measured from a straight line drawn from the leading and trailing edges of the wing, should be approximately 1/3 of the distance from the leading to the trailing edge, back of the leading edge.

This is shown graphically in Figure 6. In the figure, XY is the curved wing surface. The distance from X to Y is called the "chord" of the wing, as indicated on the diagram. The dotted line, XY, is the chord line. The maximum height of the curve should be approximately at the point shown by the arrow C. Thus the maximum curve height is 1/3 of the chord length from the leading edge, X. Wings which have this type of curved surface will give greater efficiency than any other type of single surface wing.

This term, "single surface," causes one to suspect that there are other features about a wing which are important in the creation of lift. These will be discussed in the next article of this series, together with other important facts.